

Results from HCAL TB2004 & Inputs for P-TDR

Shuichi Kunori
U. of Maryland
20-June-2005
(last update: 17-June-05, 18:00)

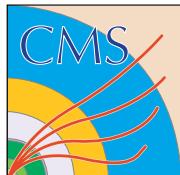
For more detail, see:

HCAL fall meeting, Fermilab 11&13-Nov.2004 <http://agenda.cern.ch/fullAgenda.php?ida=a044477>

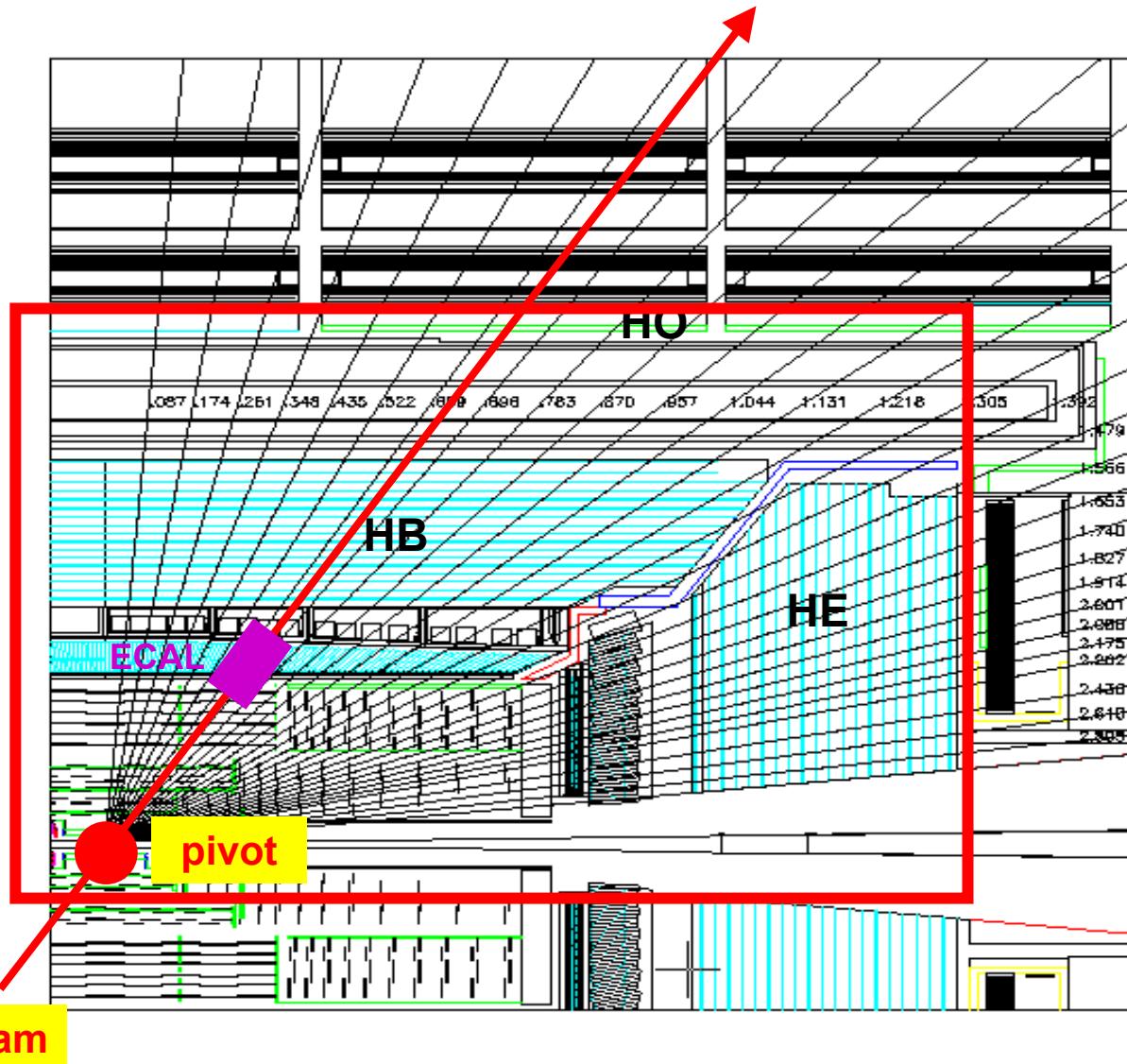
9th RDMS Annual CMS Conference, Minsk, 01-Dec-2004 <http://agenda.cern.ch/fullAgenda.php?ida=a044186>



General



HCAL on a Table at H2



Pivot of table
= IP at LHC

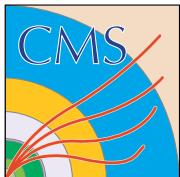
A phi slice of
CMS HCAL

HB: 2 wedges
8 ϕ segments
 $\Delta\phi = 40\text{deg.}$

HE: 4 ϕ segments
 $\Delta\phi = 20\text{ deg.}$

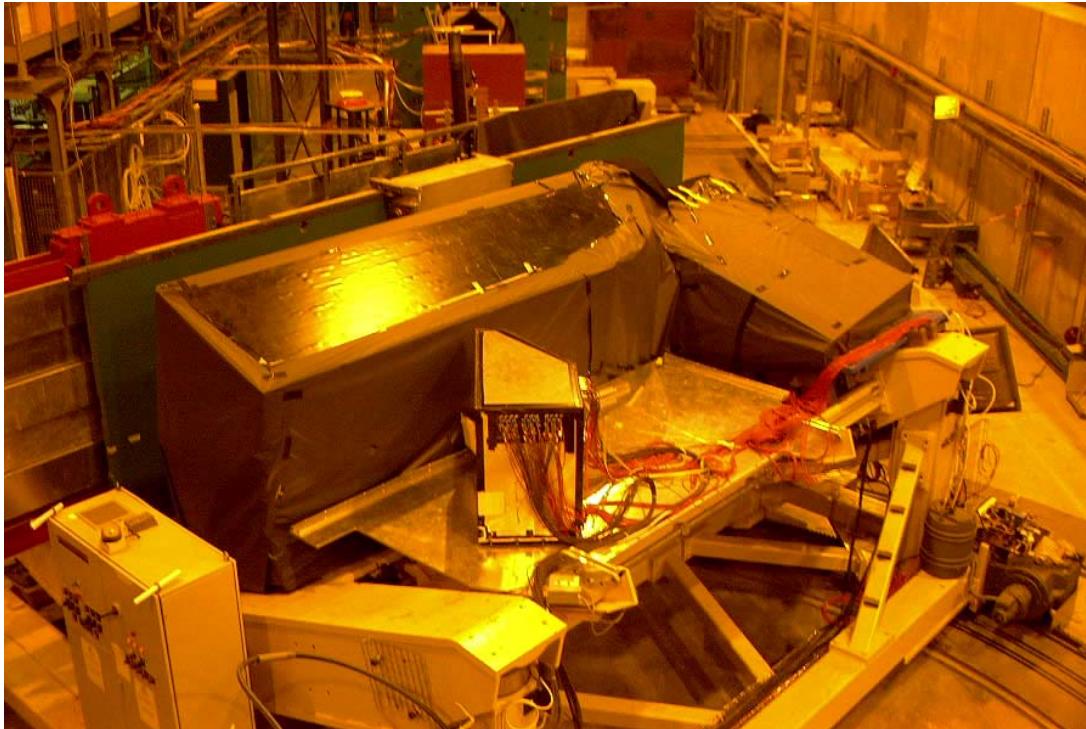
HO: 6 ϕ sector
 $\Delta\phi = 30\text{ deg.}$

ECAL: 7x7 crystals



Test Beam: 2002-2003

2 HB production wedges, 1 HE prototype wedge
HO layers on a movable table at CERN H2 beam line.

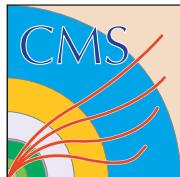


2002/03: pi- 20-300GeV, e- 20-100GeV, mu- 225GeV

Goal:

- Test the integrated system with production modules
- Verify γ source calibration
- Source/ADC vs. GeV/ADC
- Operate all calibration tools and look for improvement.
- measure basic parameters for MC, e.g.
 - pulse shape
 - signal timing
 - attenuation
 - noise
 - gaps between modules
 - resolution and linearity

All achieved! (repeated in 2004)



TB2004 Goals

Take data set for G4 validation

- Low energy / high energy data with particle ID
- Longitudinal/Transverse shower profile
- + new QIE (time slew, noise, pulse shape)

Test full system → Slice Test with EMU

- Clock distribution / Synchronization
- HTR: L1 primitive generation ($\text{ADC} \rightarrow E_T$), Threshold

Operate all calibration tools and develop algorithm & code

- Wire source/ Laser / LED (including synchronization)
→ detect 1% gain change
- + demonstrate that HF calibration scheme work.

Deploy prototype HCAL database

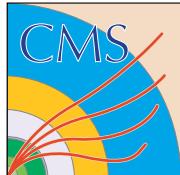
- Conditions DB / Construction DB / Configuration DB etc.

Operate remote monitoring and analysis (+debugging)

- E-logbook, video/audio system + other tools (desk top exchange) etc.
- DCS monitoring data.

Feed data into ORCA

- Interface to raw data and conditions DB.



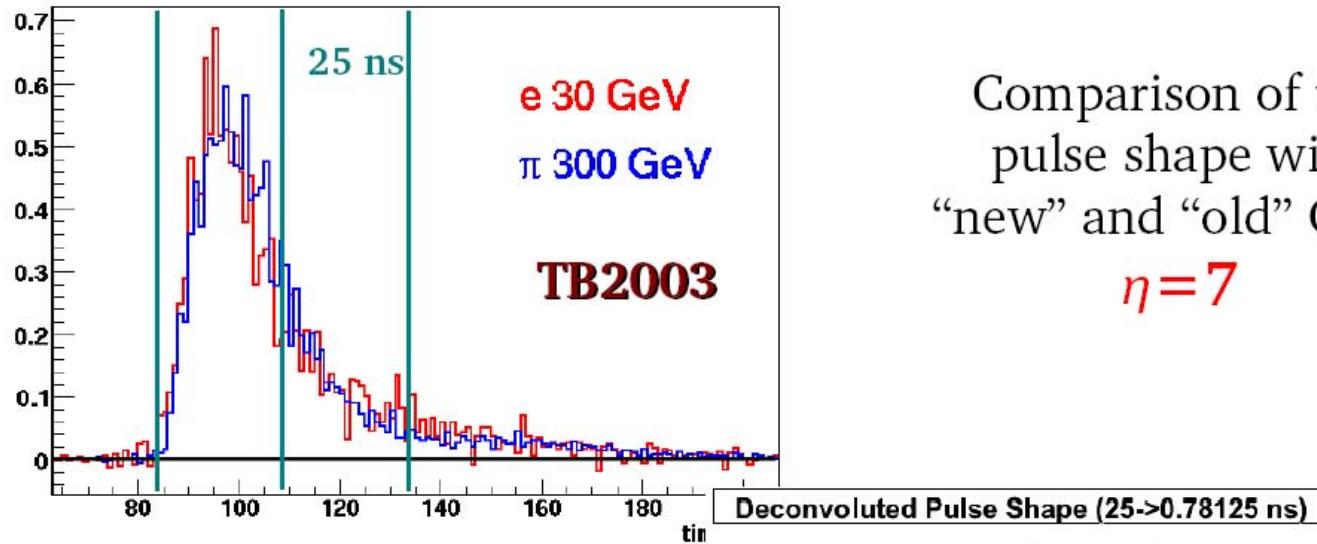
Summary of TB2004 runs

- May 17-Jun8 , High energy run
- Jun 8-14, no beam time install HO
- Jun 14-21 25 ns run time
- Jun 25- Jul 7: first HF run
- Jul 7-14 : 1st week of VLE run
- Jul 14- Aug11 : second HF run
- Aug 11- 18: 2nd week of VLE run
- Aug 18- Sep 22: other experiments in H2
- Sep 22-Oct 4: HCAL-EMU setup
- Oct 4-11 25ns HCAL-EMU run
- Oct 13-18: 3rd week of VLE run
- Feb.'05 Wire source calibration run

Slice Test

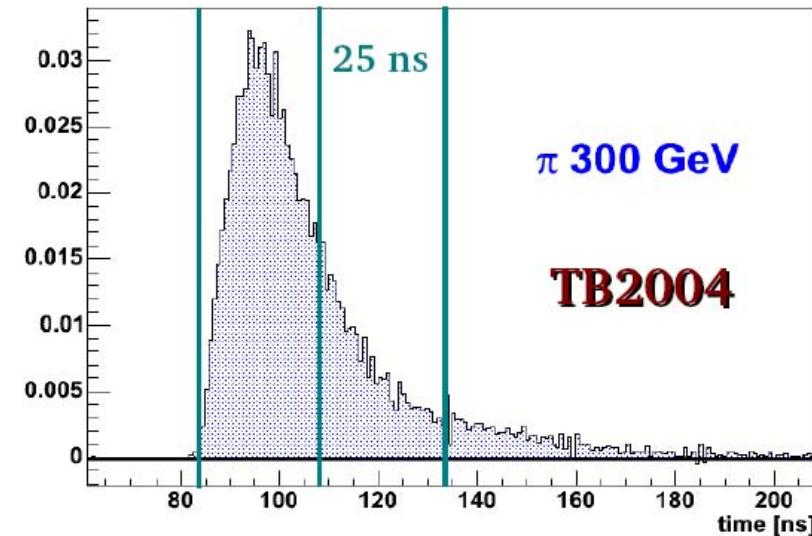


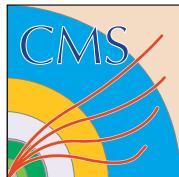
QIE Pulse Shape: New vs Old



No significant difference in the QIE pulse shape .

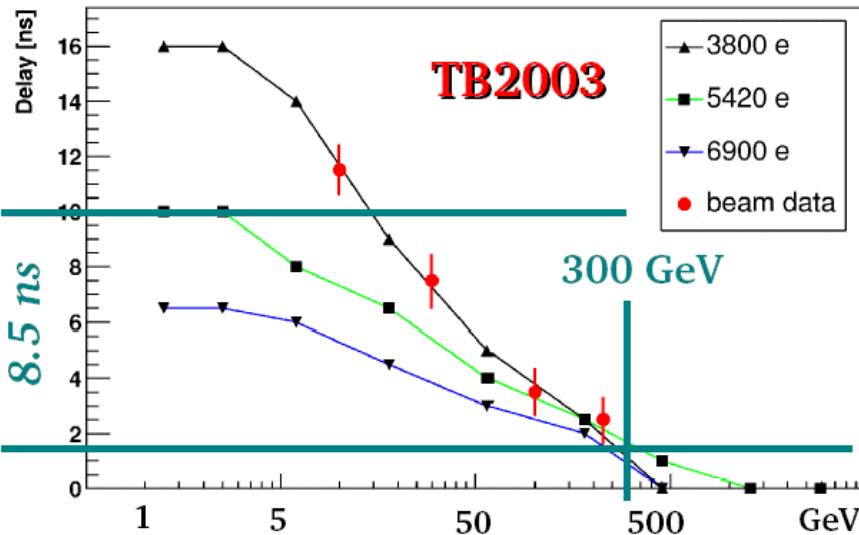
88% signal collection
In 2 time slices.



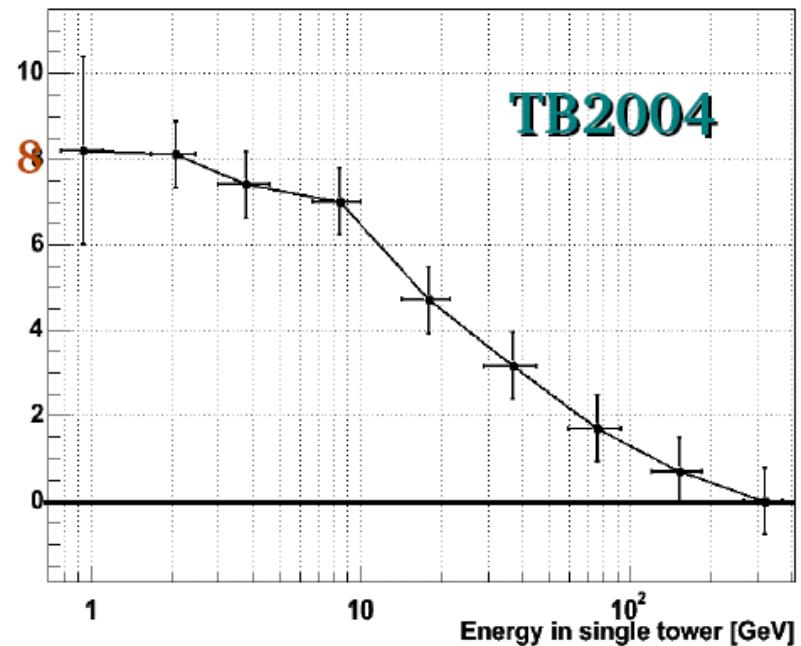


QIE Time Slew

On chip measurement

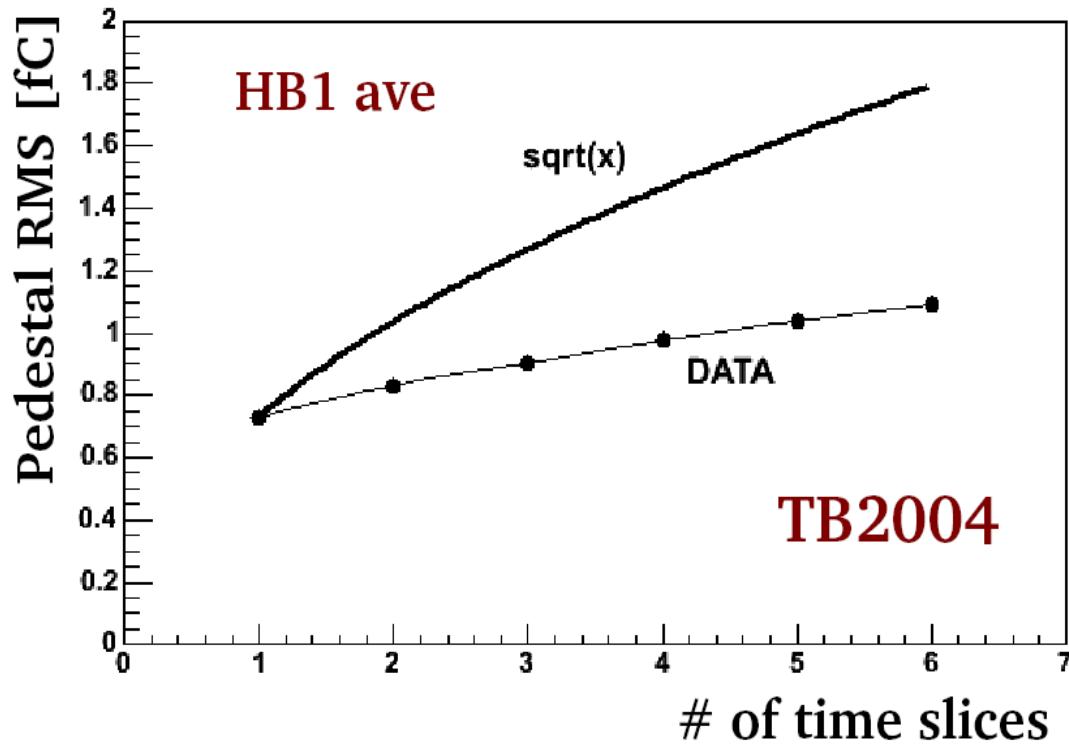


New faster QIE for HB/HE



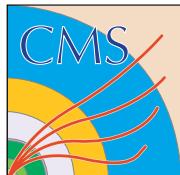


QIE Noise

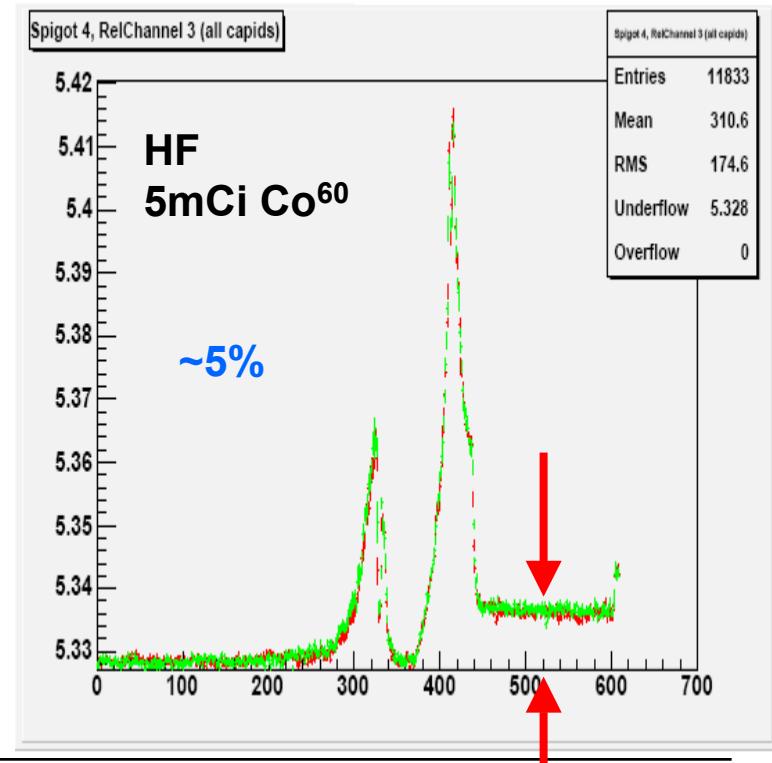
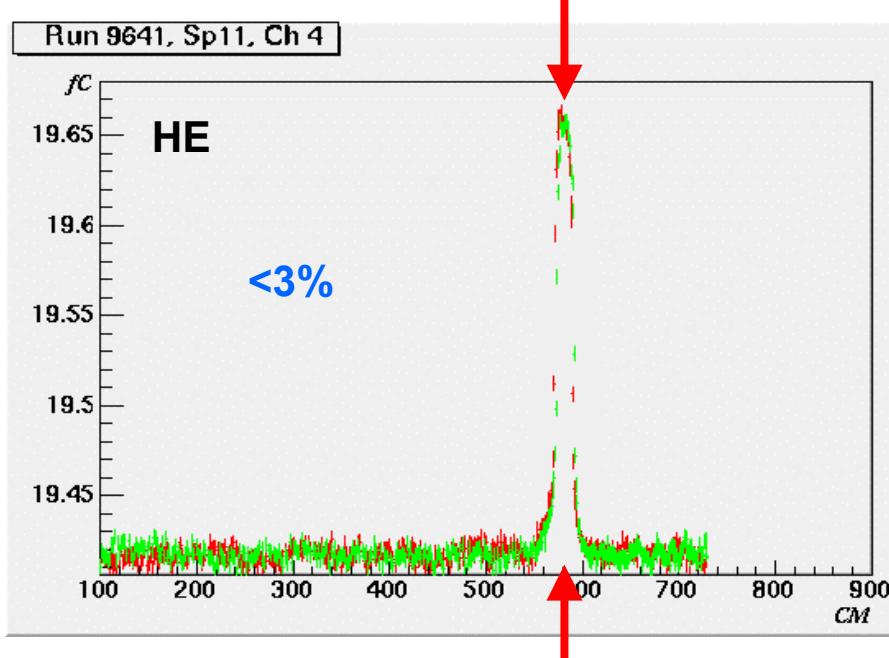
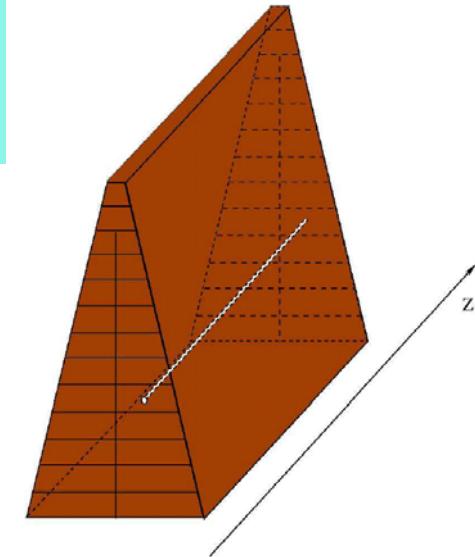
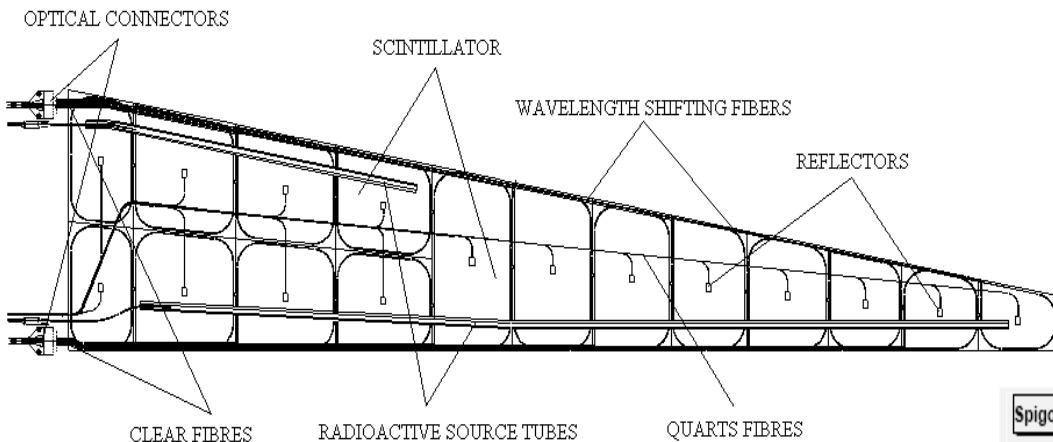


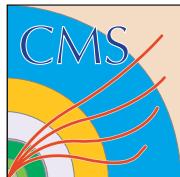
ped. RMS (1 ts.)
TB2004: 0.730 fC
TB2003: 0.586 fC

1.25 higher noise
w.r.t. TB2003,
1.43 expected

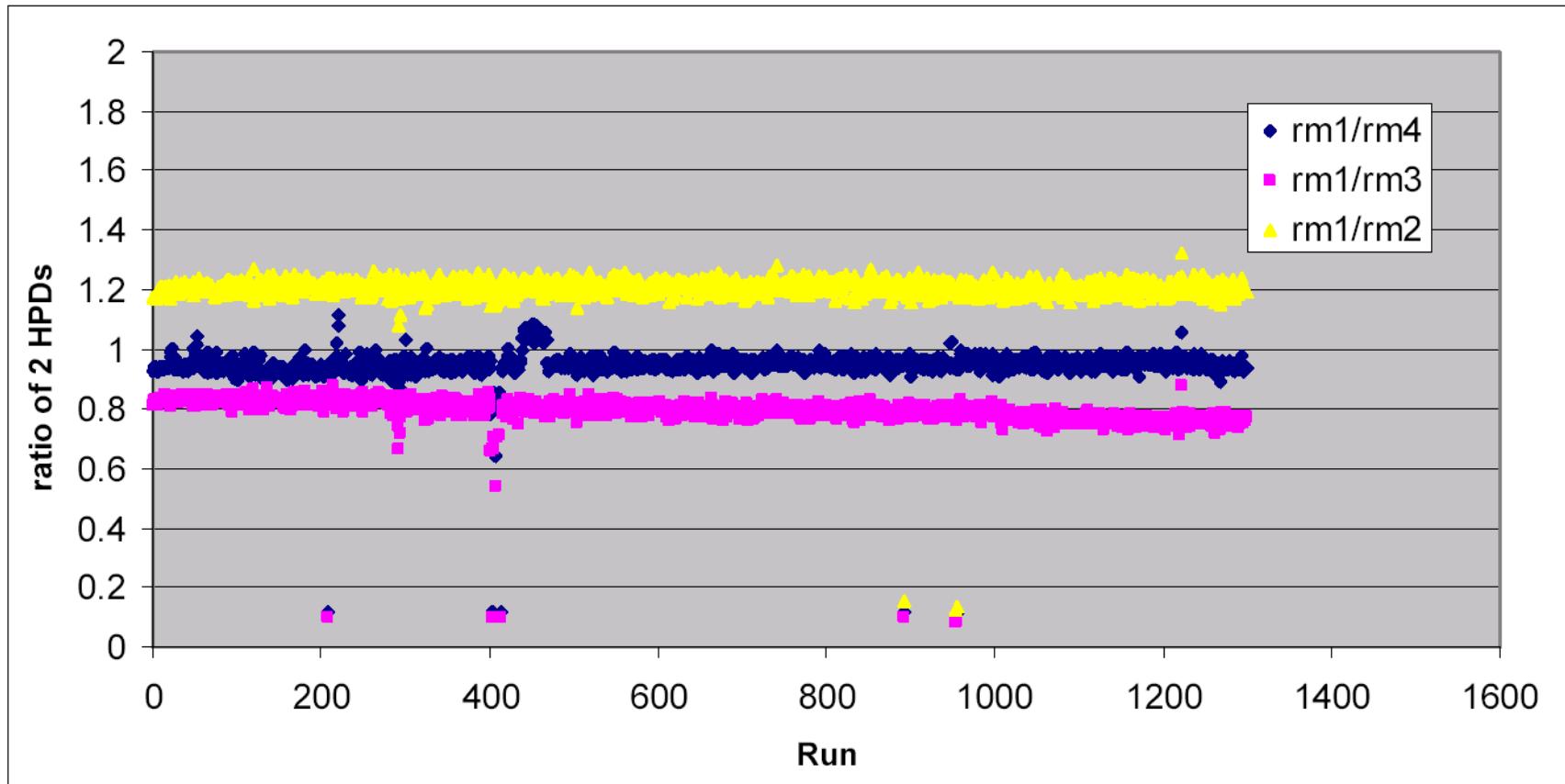


Wire Source Calibration



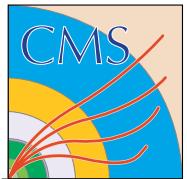


HPD Stability

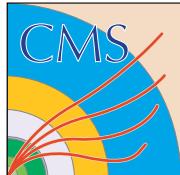




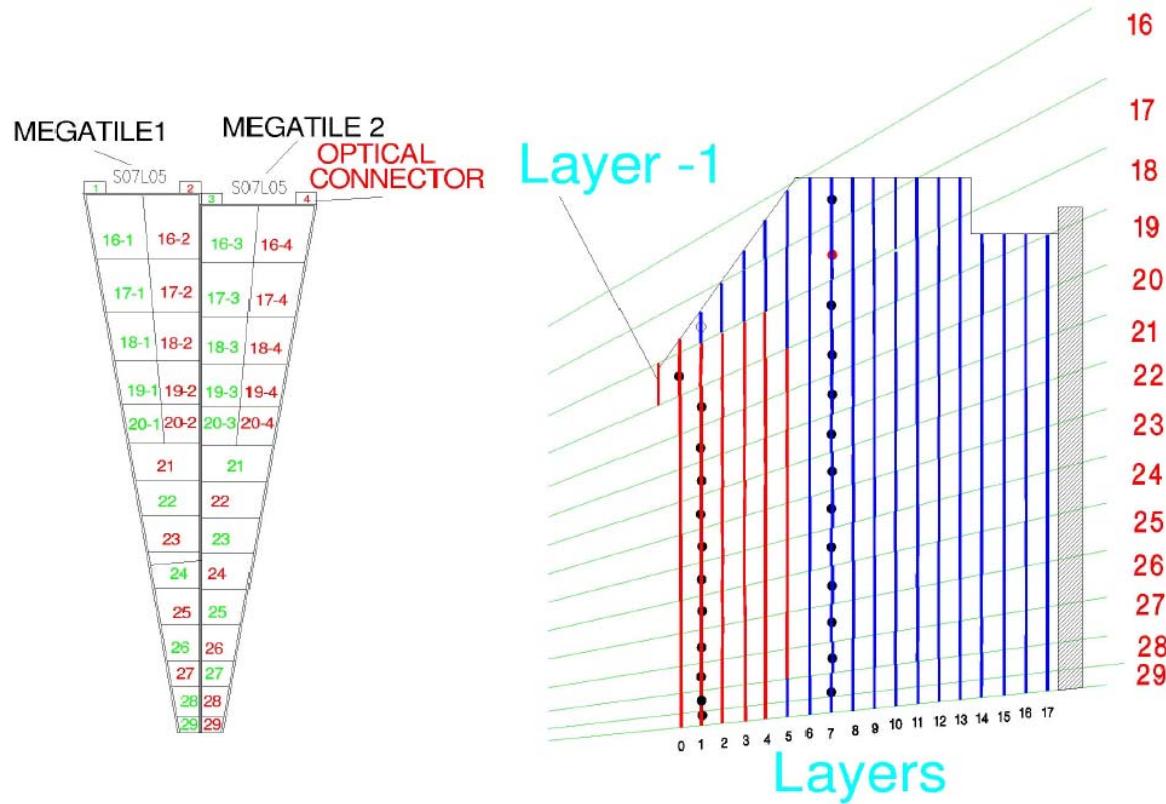
HB



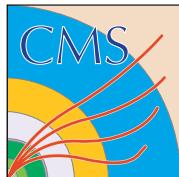
HE (2003)



HE Setup (TB2003)

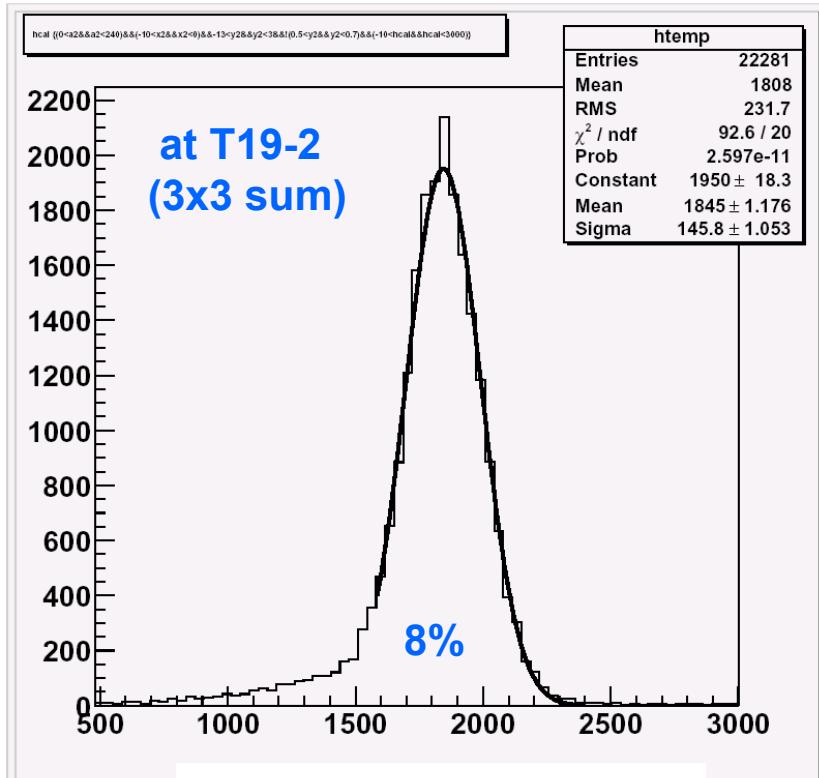


**3×3 towers with the tower 19-2 in the center
were tested completely (WS,laser, e , μ , π)**



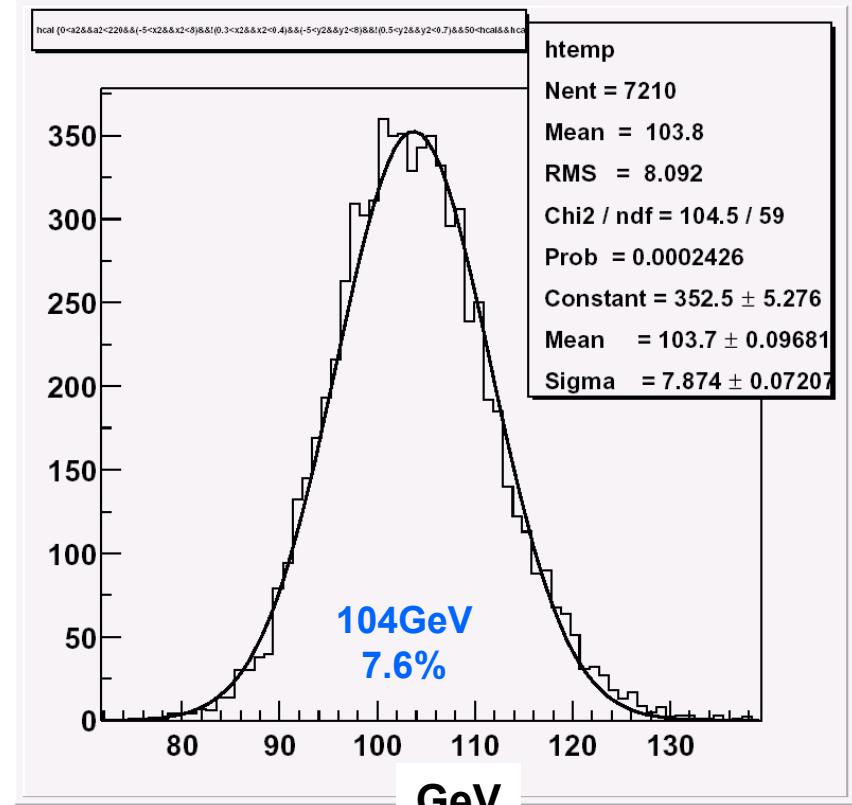
HE Response (2003)

300GeV pi-



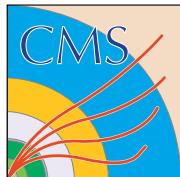
0.163GeV/ADC

100GeV e-

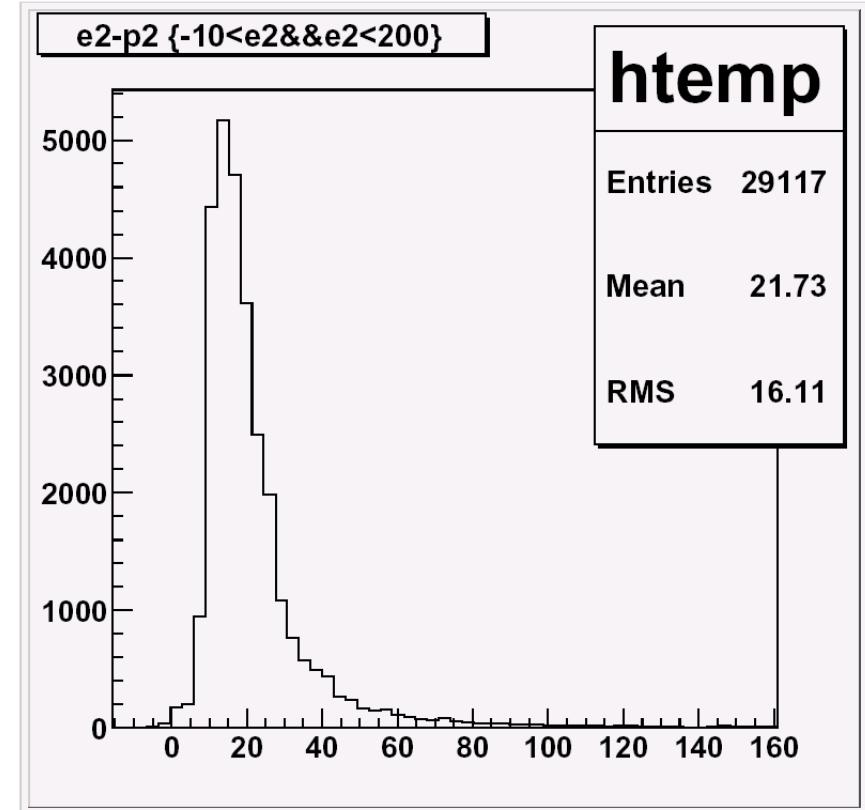
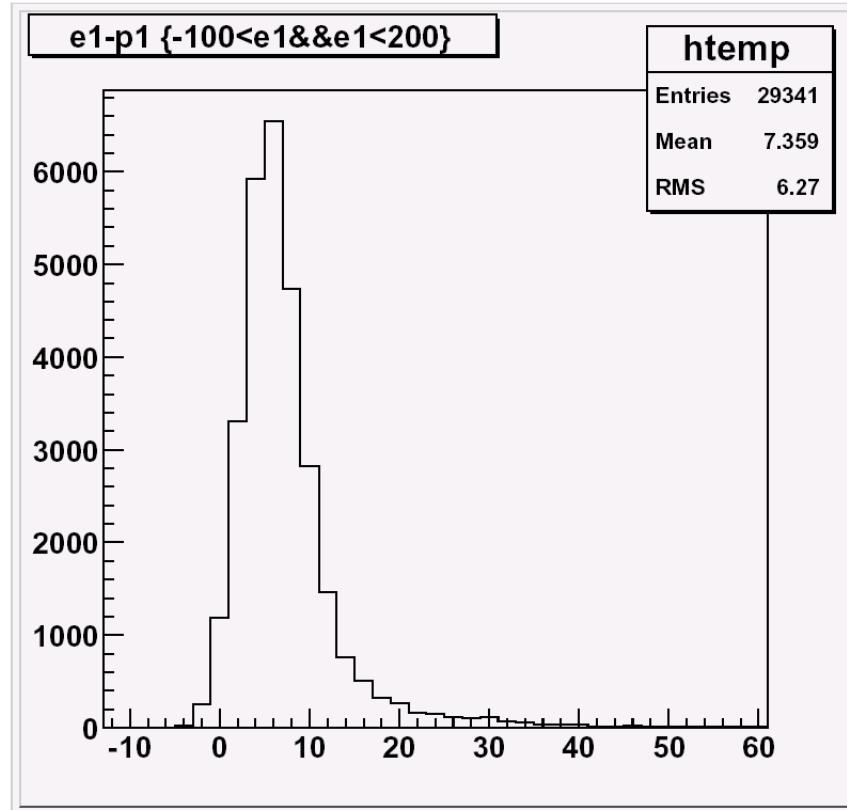


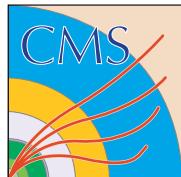
(calibrated with 300GeV pion)

V.Ladygin, A.Volkov, RDMS Meeting @ Dubna, 05-Dec-2003

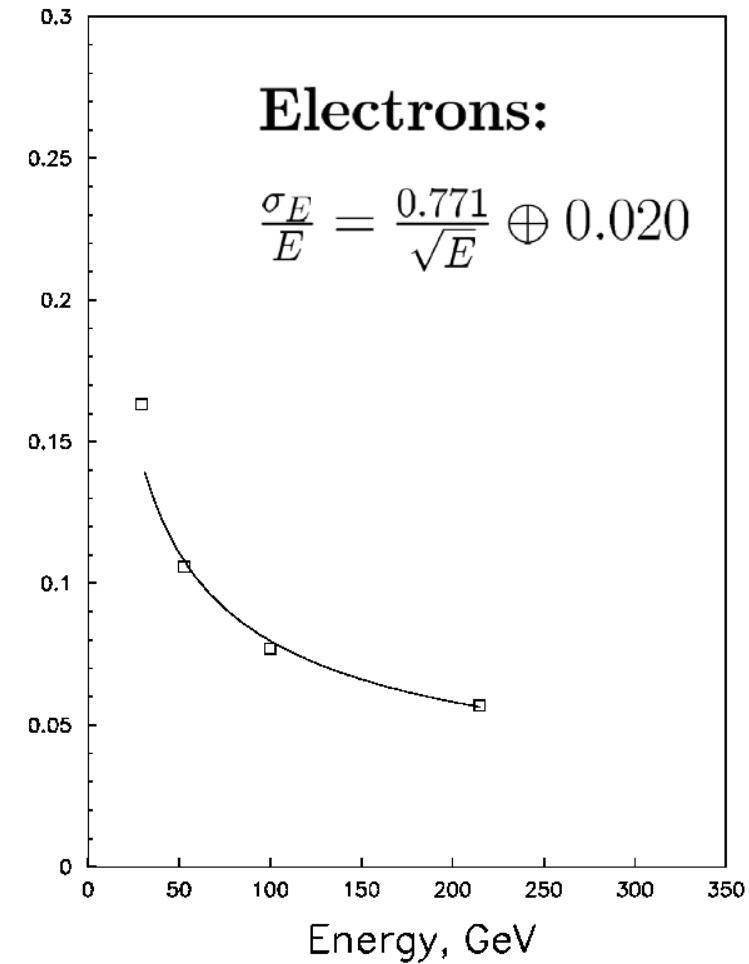
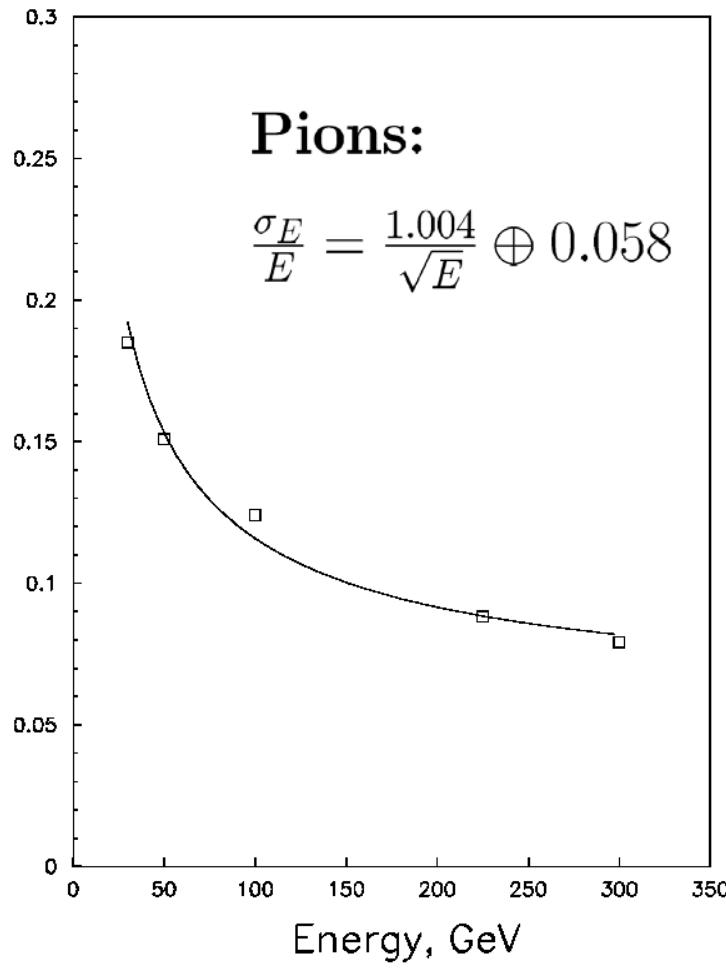


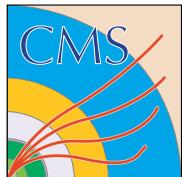
Muons in HE



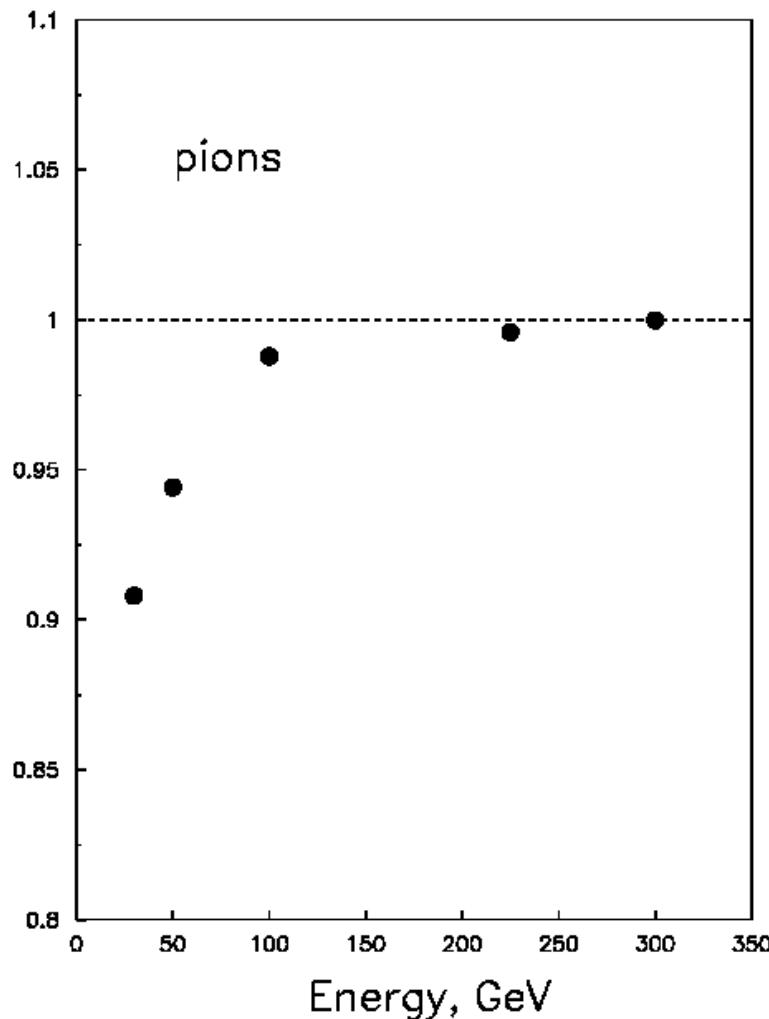


TB03 HE



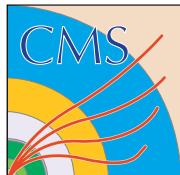


TB03 HE

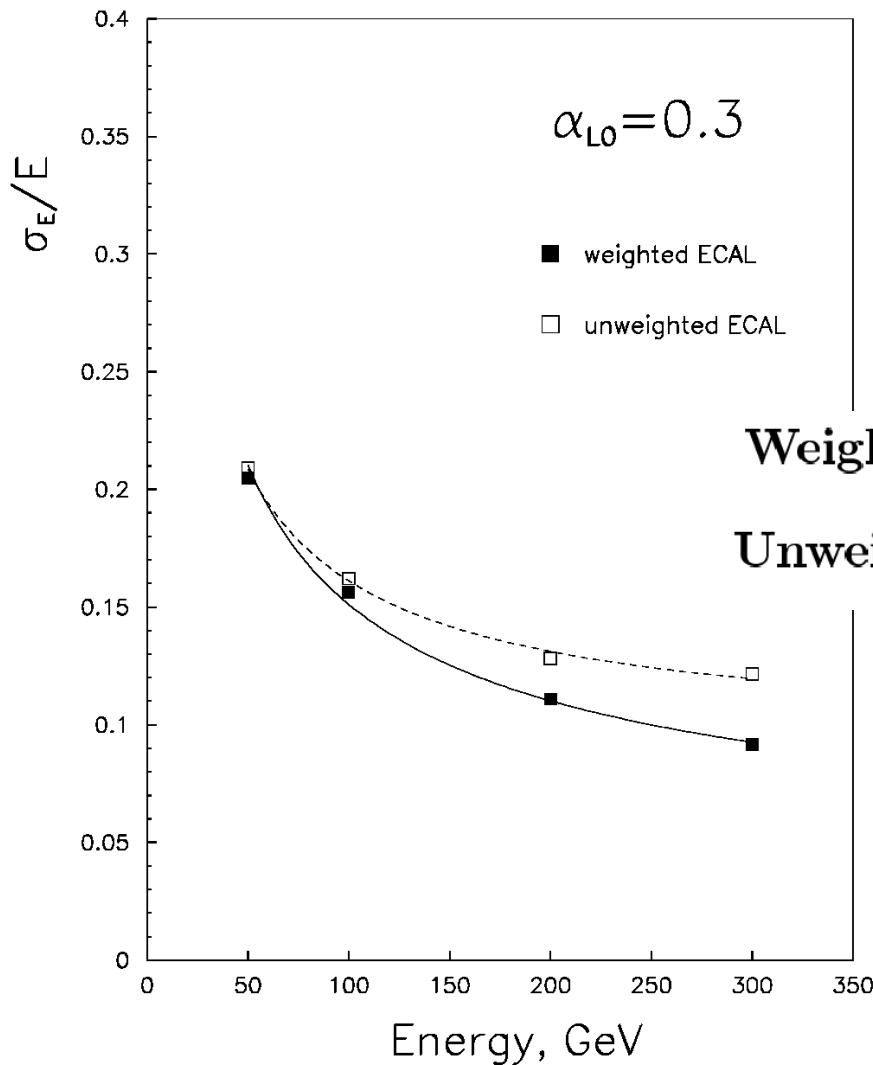


$$E_e - E_\pi(100 \text{ GeV}) = 4.5 \text{ GeV}$$

$$e/h \sim 1.3$$



TB03 HE

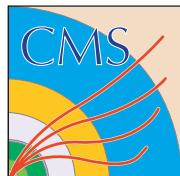


Weighted ECAL:

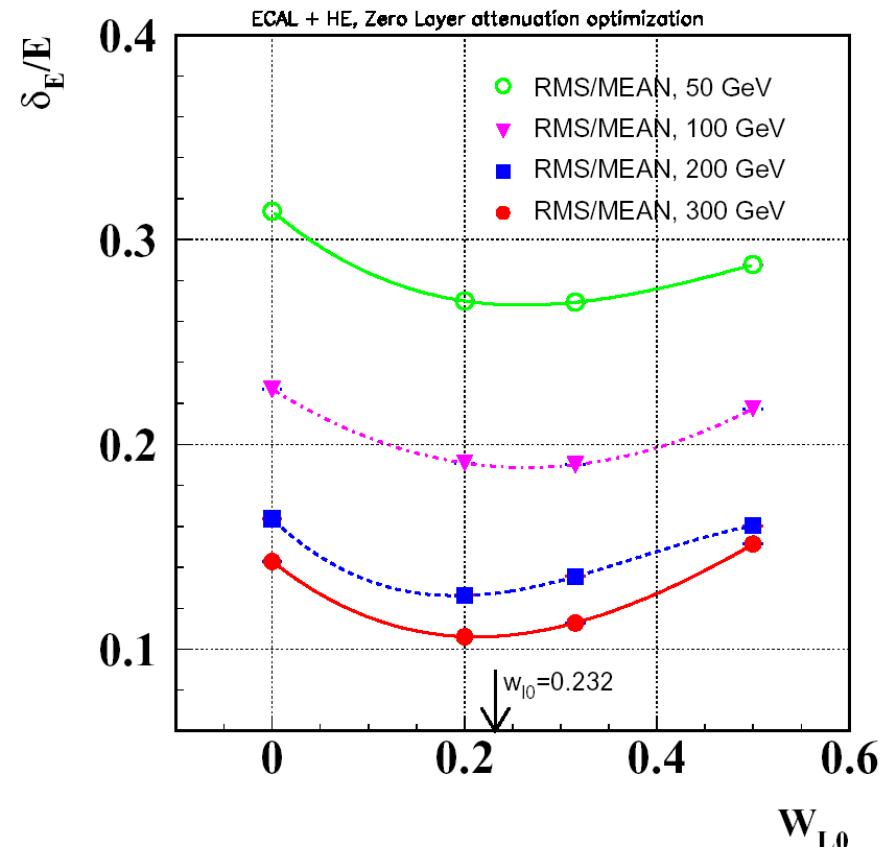
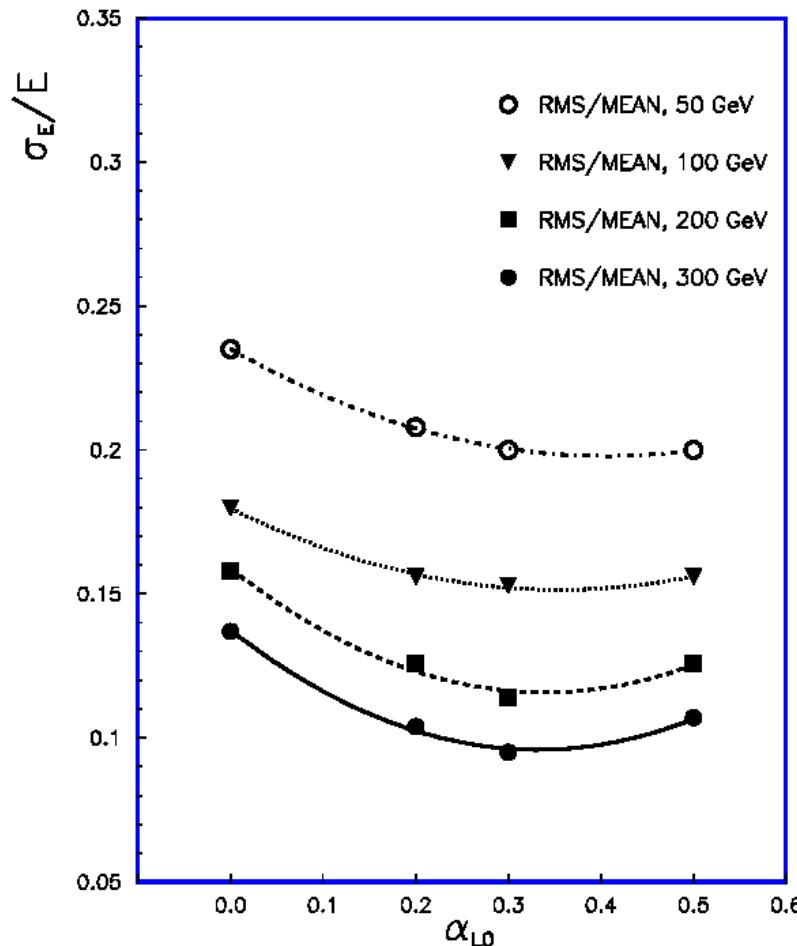
$$\frac{\sigma_E}{E} = \frac{1.463}{\sqrt{E}} \oplus 0.038$$

Unweighted ECAL:

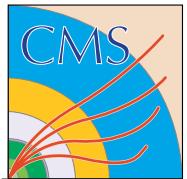
$$\frac{\sigma_E}{E} = \frac{1.324}{\sqrt{E}} \oplus 0.092$$



L0 Optimization

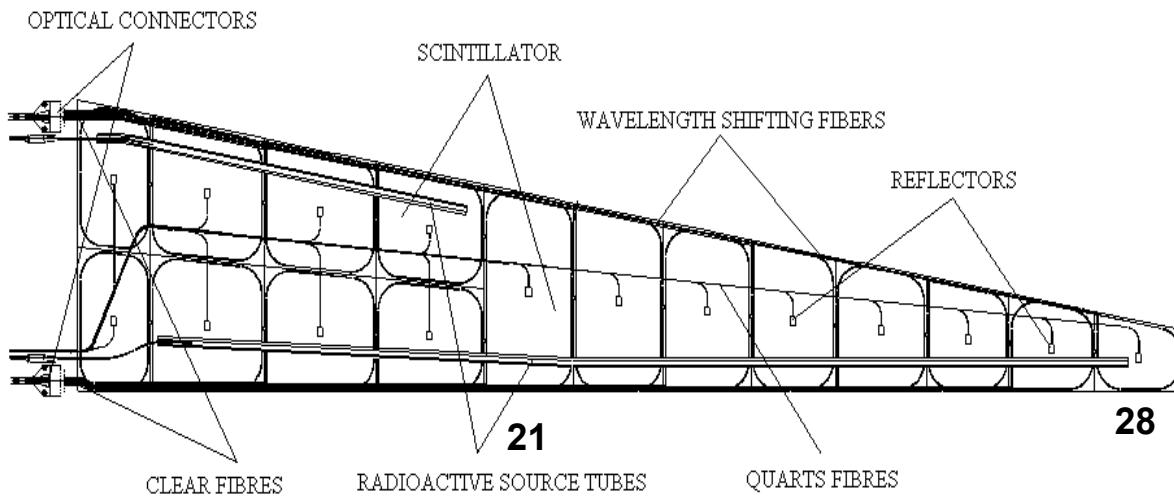


Weight for ECAL only

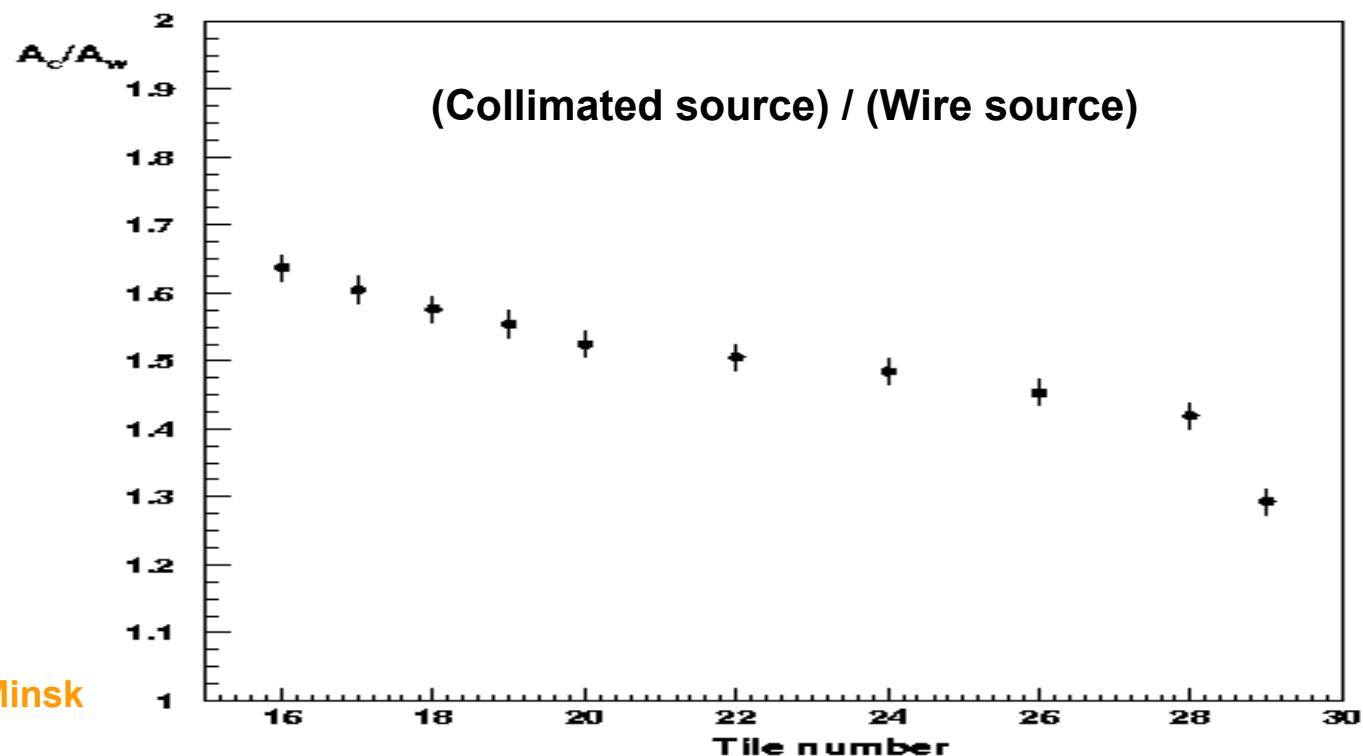


HE (2004)

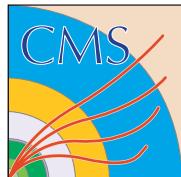
HE



Source calibration



Vladimir Talgov,
RDMS meeting, Minsk
01-Dec-2004

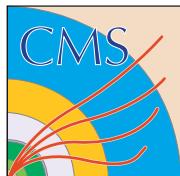


HE (TB2004)

Run 9641

Vladimir Talgov,
RDMS meeting, Minsk
01-Dec-2004

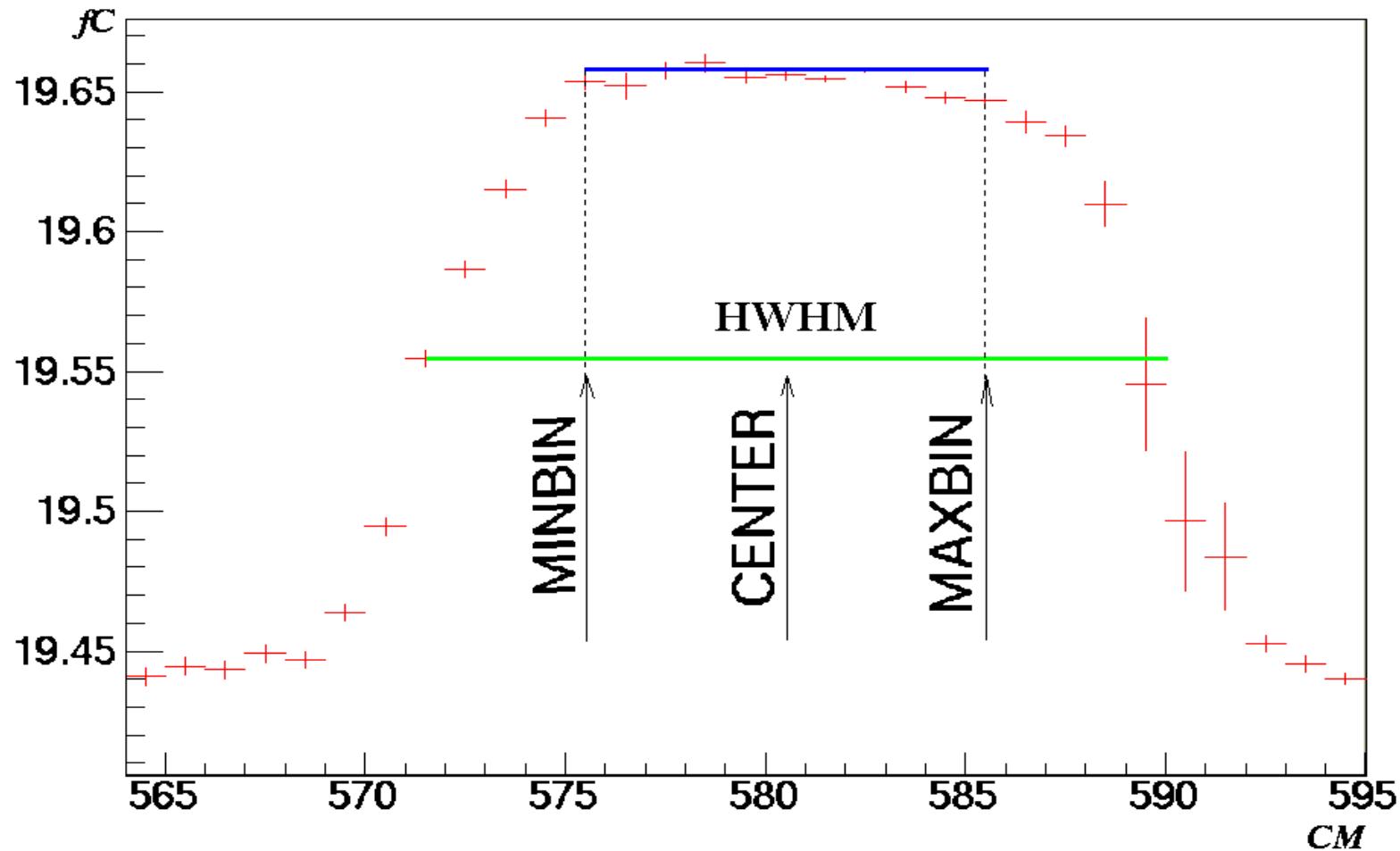
L	phi	Sp	ch	maximum	maxreel	meanped	meansig	sig-ped
1	3	11	1(17f)	18.380	568	18.151	18.371	0.221
1	3	11	3(25f)	22.119	682	21.978	22.115	0.137
1	3	11	4(18f)	19.660	579	19.417	19.656	0.240
1	3	11	7(27f)	19.581	707	19.412	19.578	0.166
1	3	11	12(23f)	18.736	654	18.525	18.734	0.210
1	3	11	14(20f)	20.256	614	20.060	20.255	0.195
1	3	11	16(19f)	18.314	601	18.146	18.311	0.165
1	3	11	18(21f)	19.406	629	19.237	19.398	0.160

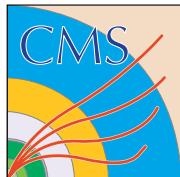


HE (TB2004)

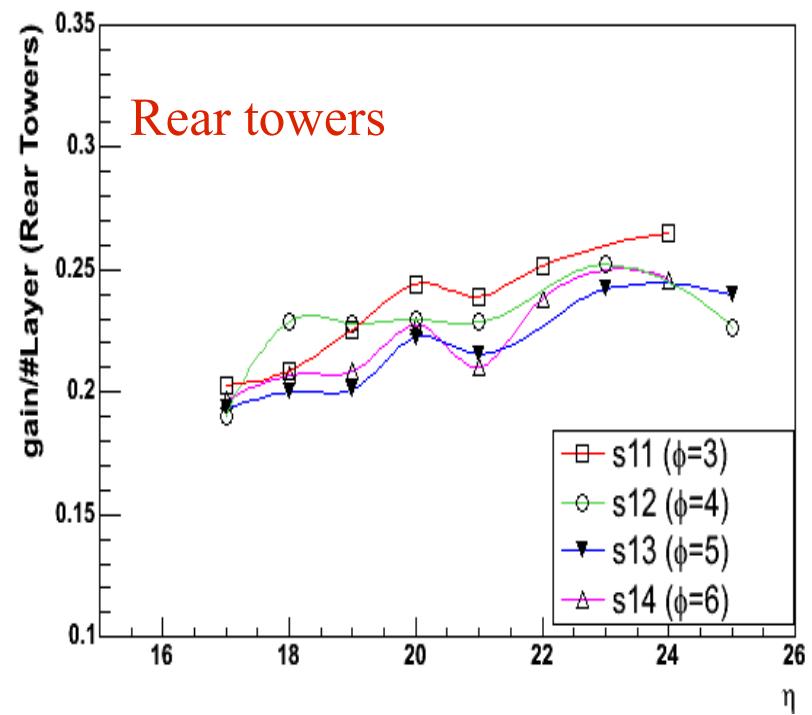
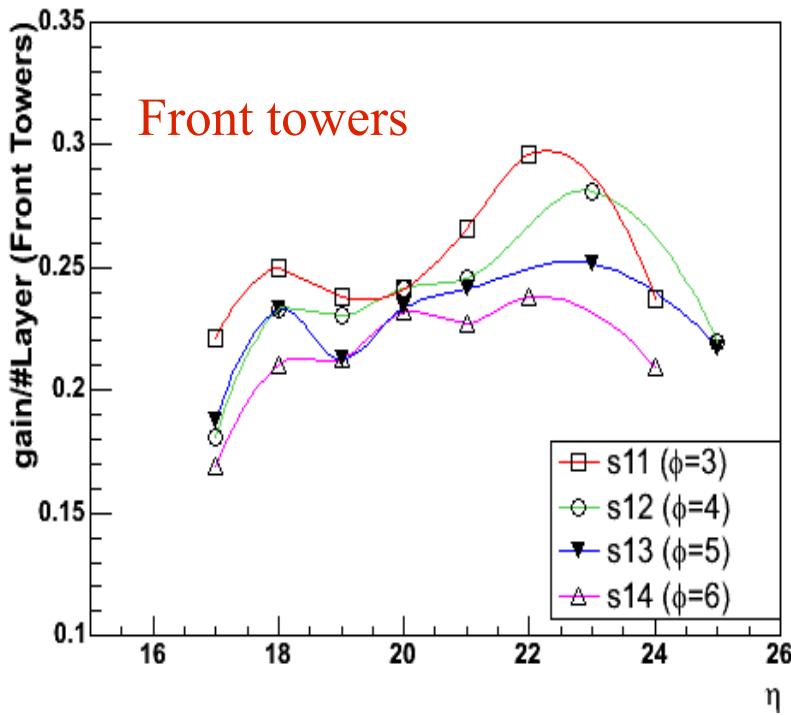
Vladimir Talgov, RDMS meeting, Minsk. 01-Dec-2004

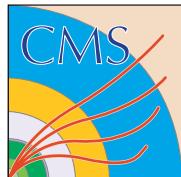
Run9641, Sp11, Ch 4



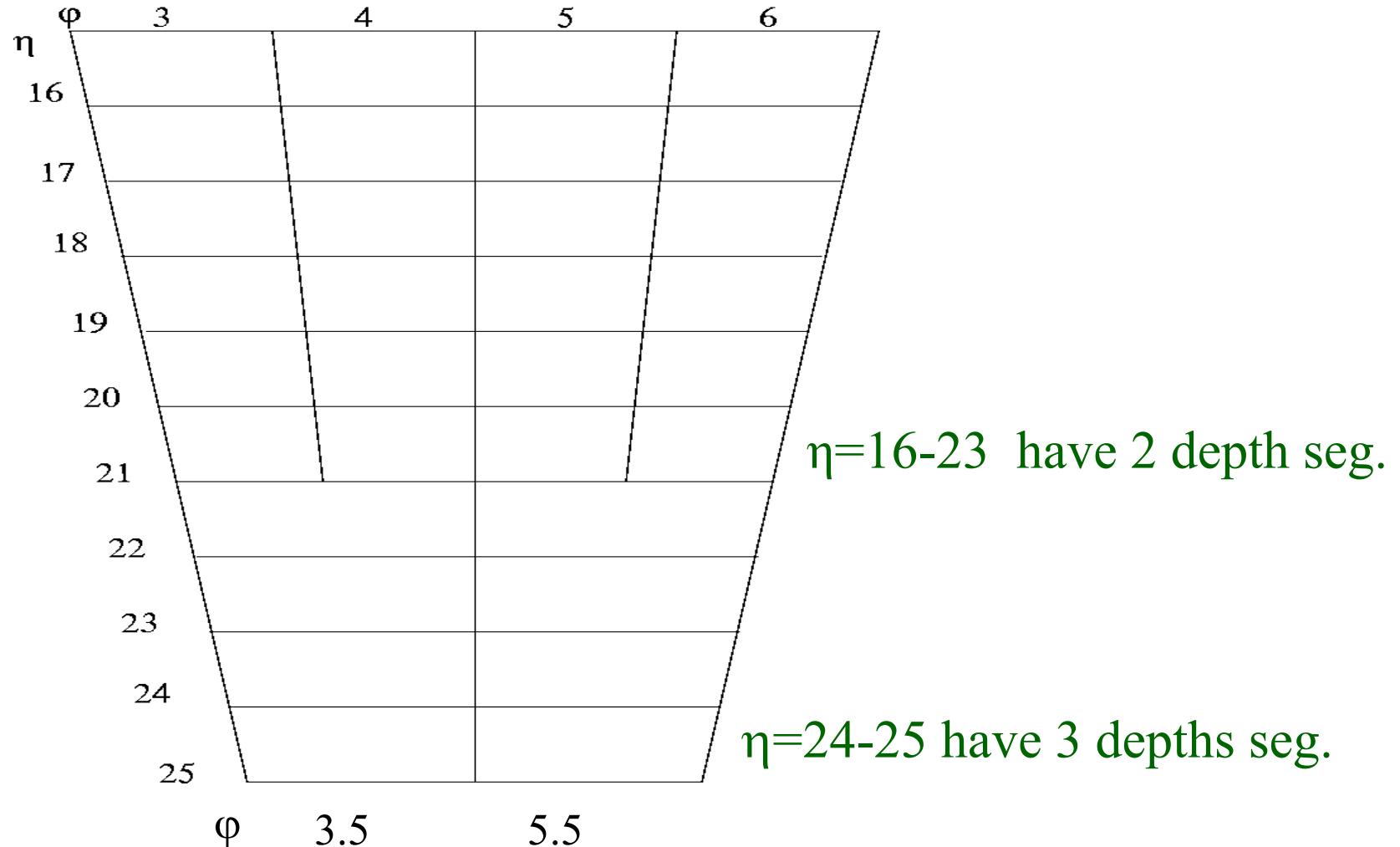


Gain from Muons (TB2004)

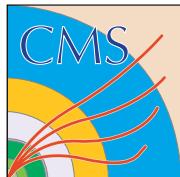




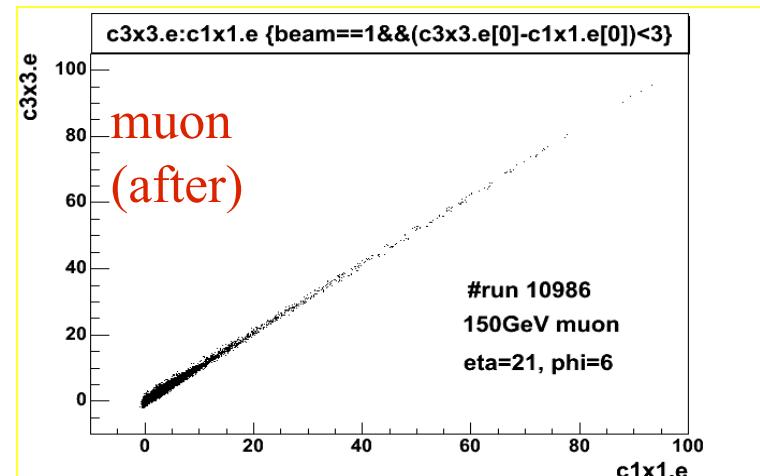
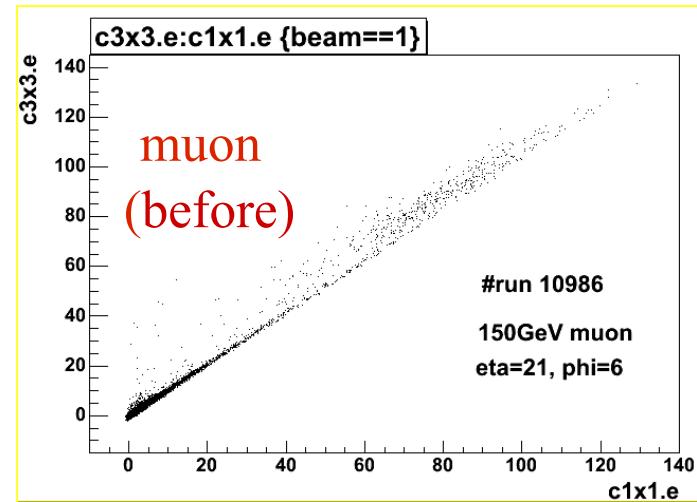
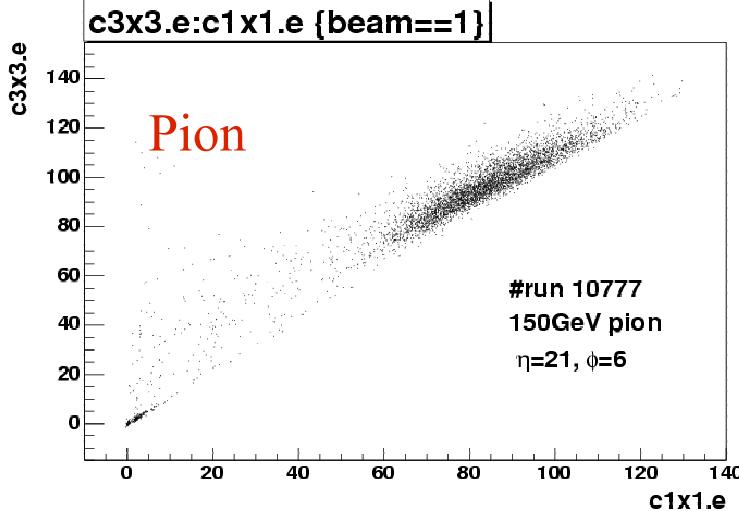
HE Geometry (TB2004)



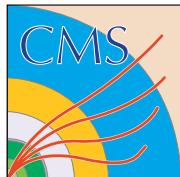
Selda Esen, HCAL meeting @FNAL, Nov-04



Pions in Muon beam

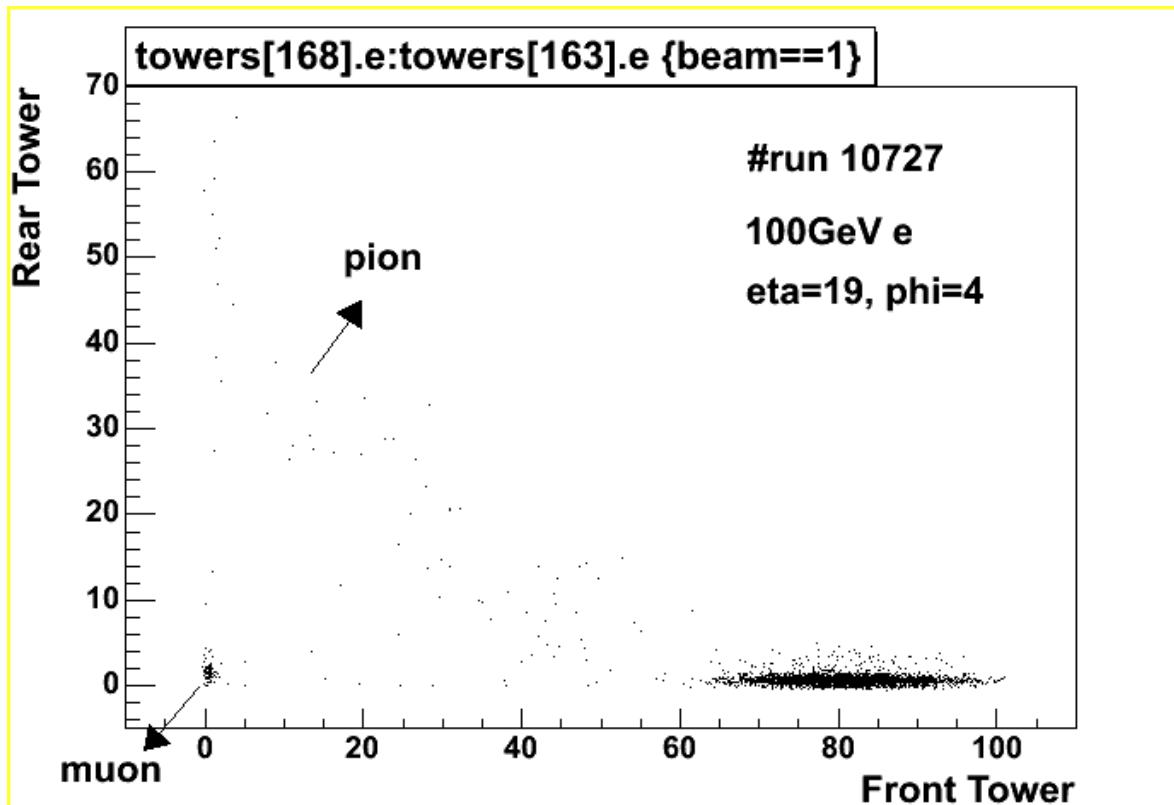


Selda Esen, HCAL meeting @FNAL, Nov-04

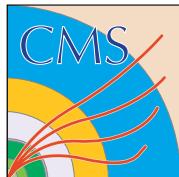


Muons and Pions in electron beam

- Looked at the beam contamination:
 - Removed muons and pions from the e data

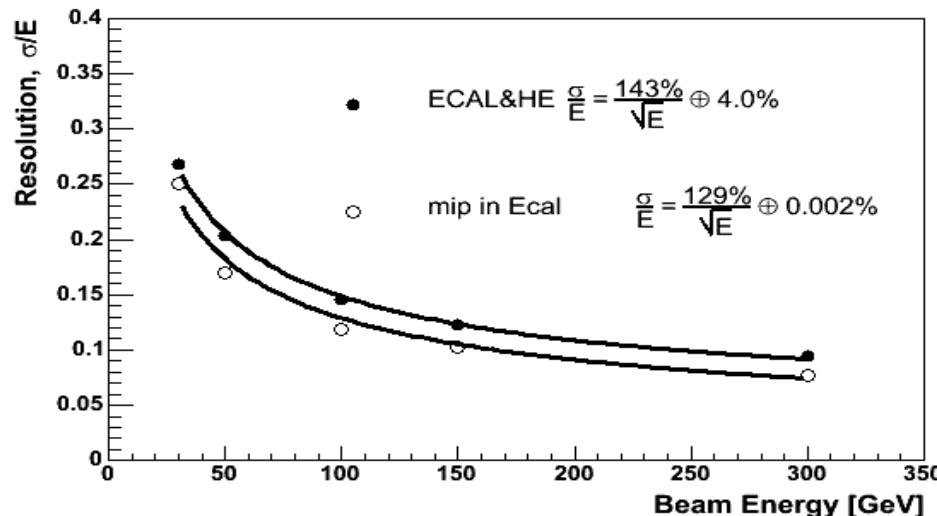
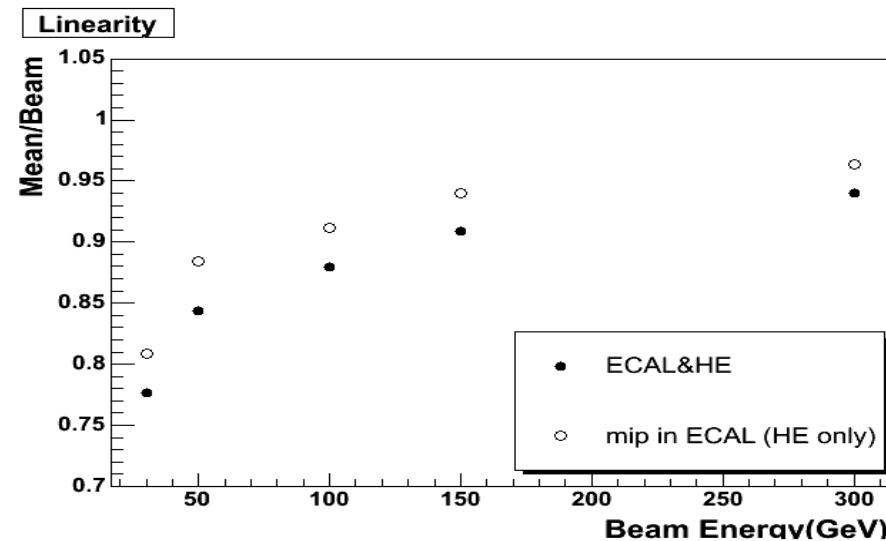


Selda Esen, HCAL meeting @FNAL, Nov-04



TB2004; HE resolution

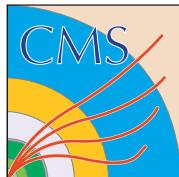
Resolution



Selda Esen, HCAL meeting @FNAL, Nov-04

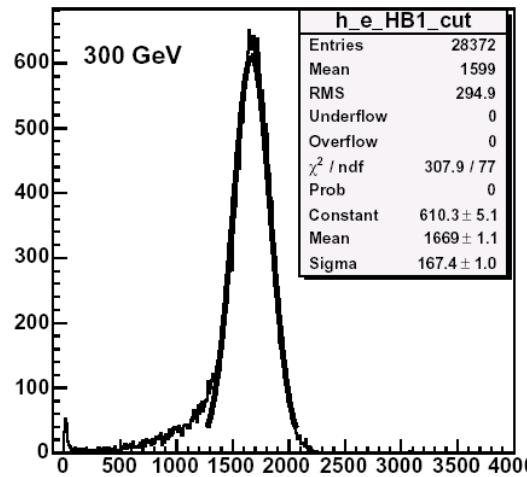


HO



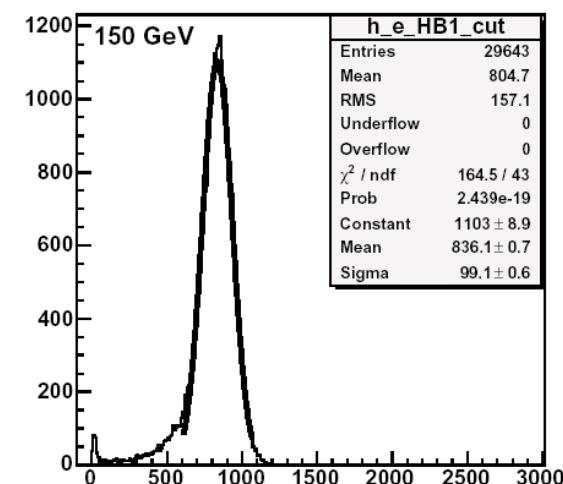
HO – Tail Catcher

Sum of Energy in 3x3 Towers of HB1, HO>10, HB>20

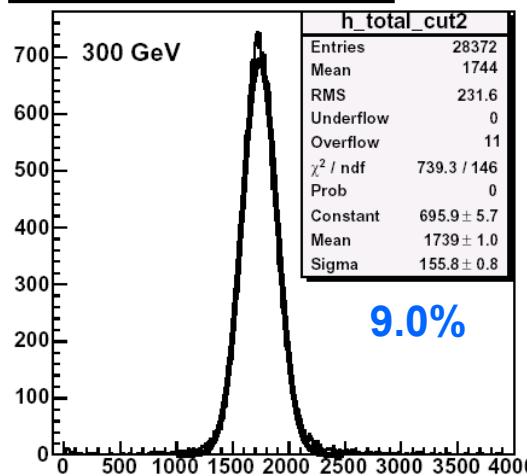


$$E = HB + 3.6 \cdot HO$$

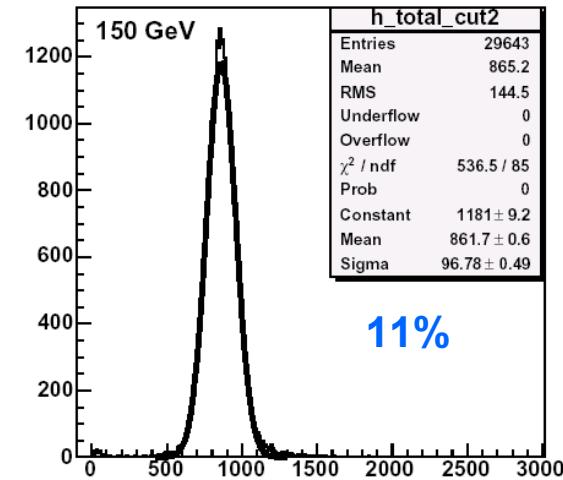
Sum of Energy in 3x3 Towers of HB1, HO>10, HB>20



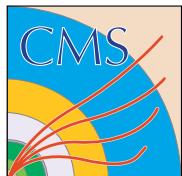
HB+HO(2), HB>20, HO>10
(fitting p0*x)



HB+HO(2), HB>20, HO>10
(using with p0*x)

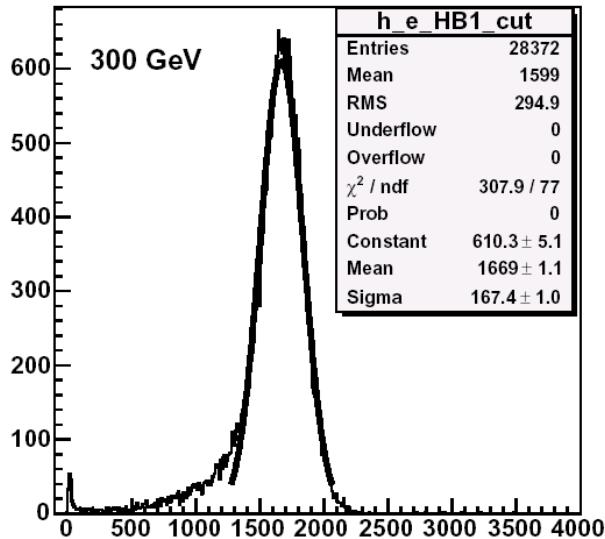


Seema Sharma, May'05

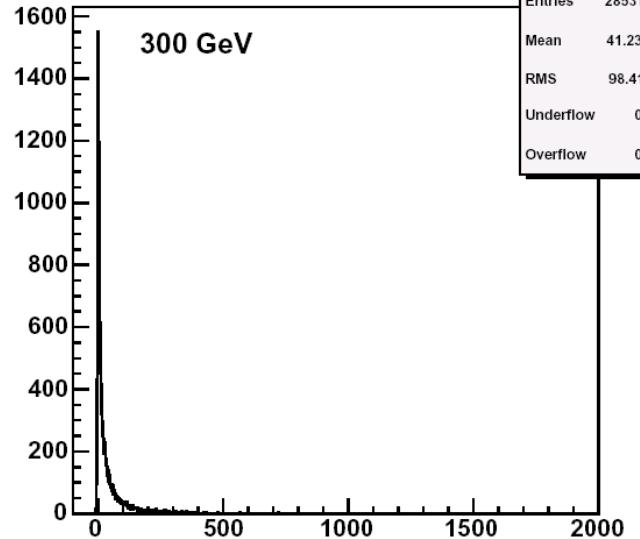


HB1+HO 300GeV

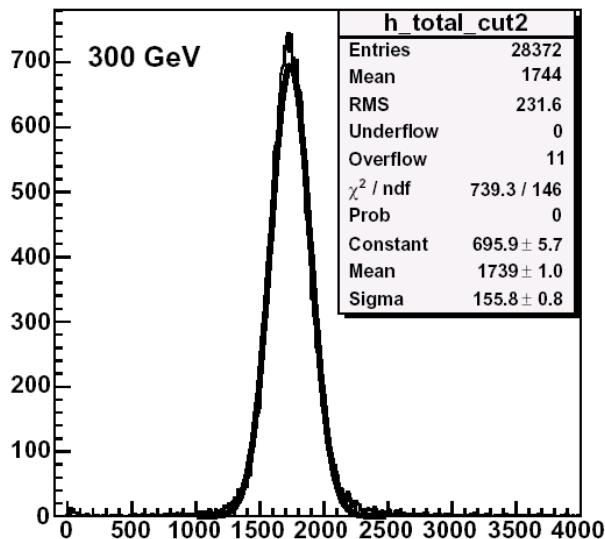
Sum of Energy in 3x3 Towers of HB1,HO>10, HB>20



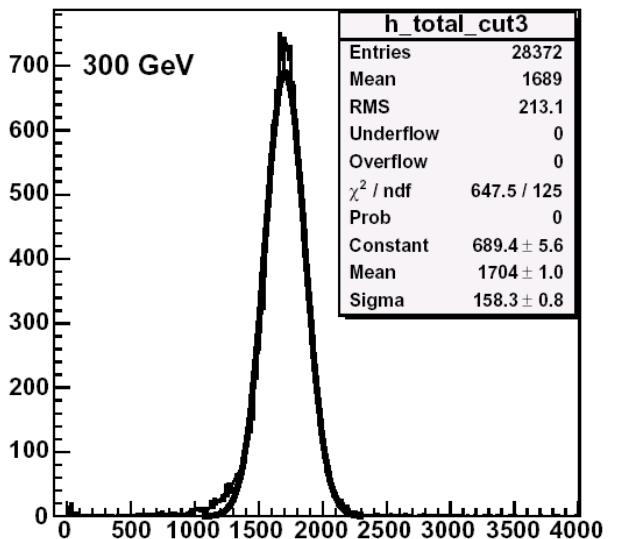
Sum of Energy in 3x3 Towers of HO1

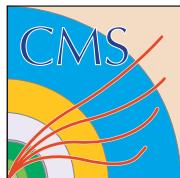


HB+HO(2), HB>20, HO>10
(fitting p0*x)



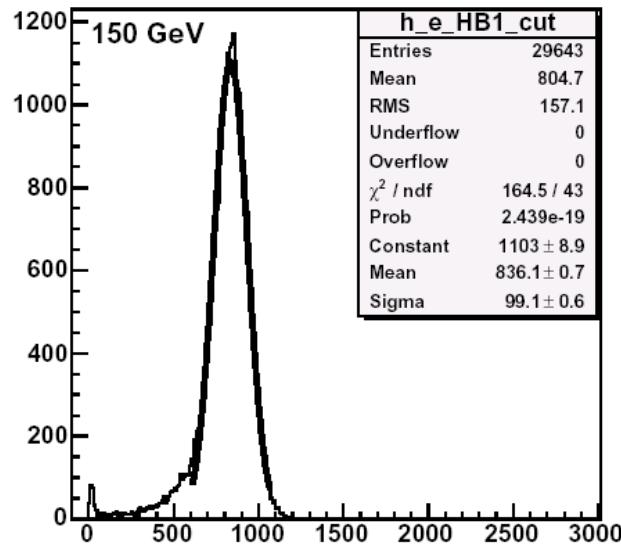
HB+HO(3), HB>20, HO>10
(min. RMS/Mean)



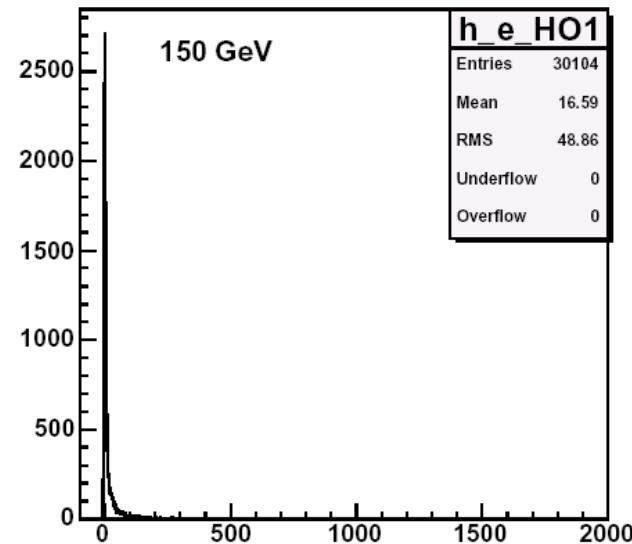


HB1+HO 150GeV

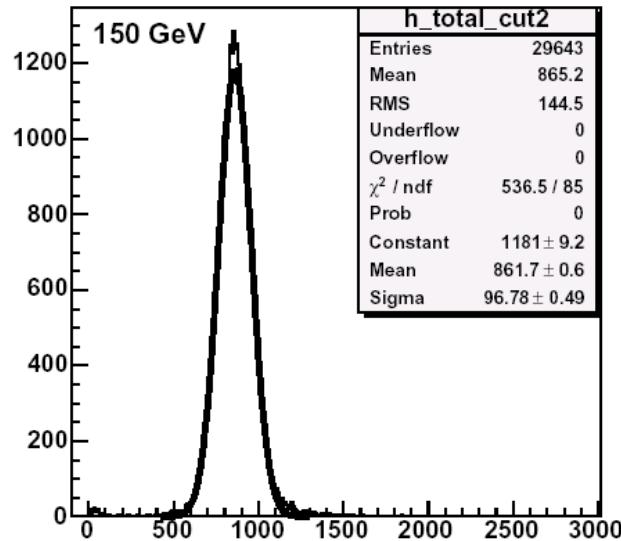
Sum of Energy in 3x3 Towers of HB1,HO>10, HB>20



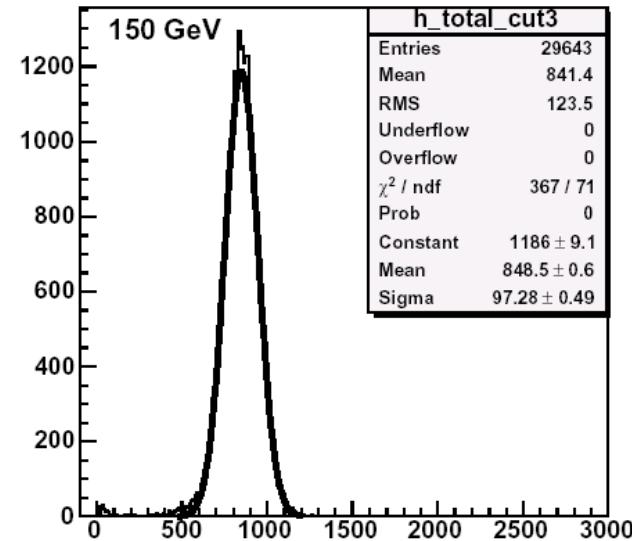
Sum of Energy in 3x3 Towers of HO1

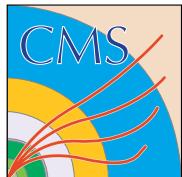


HB+HO(2), HB>20, HO>10
(using with p_0^*x)

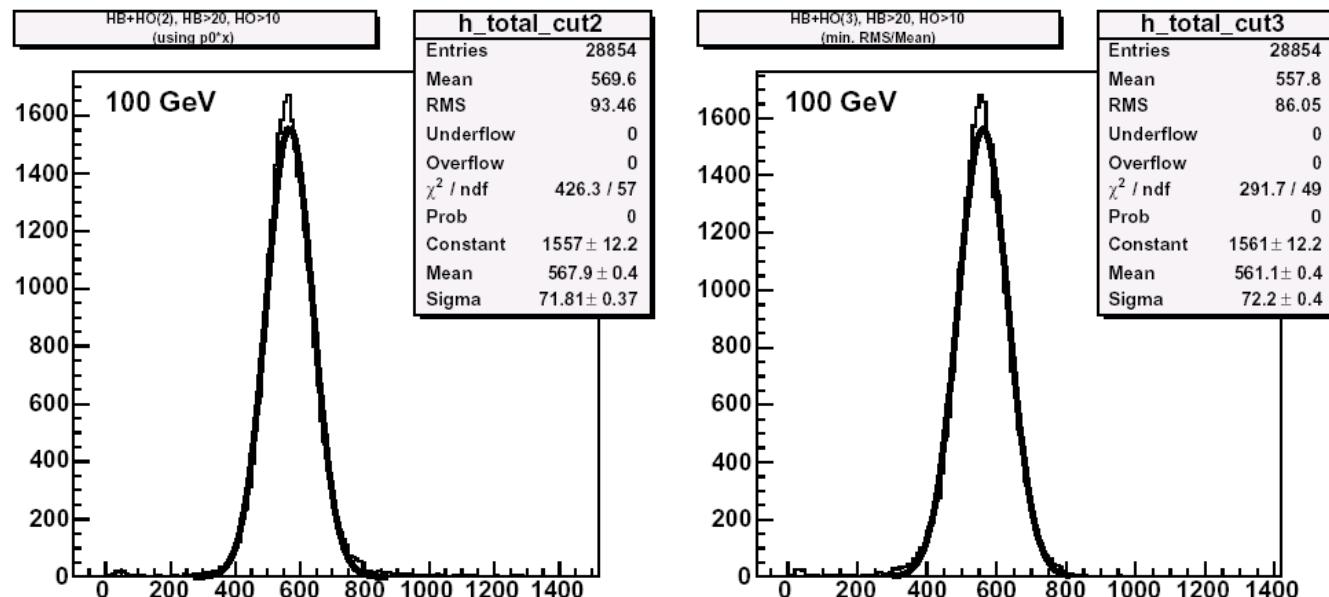
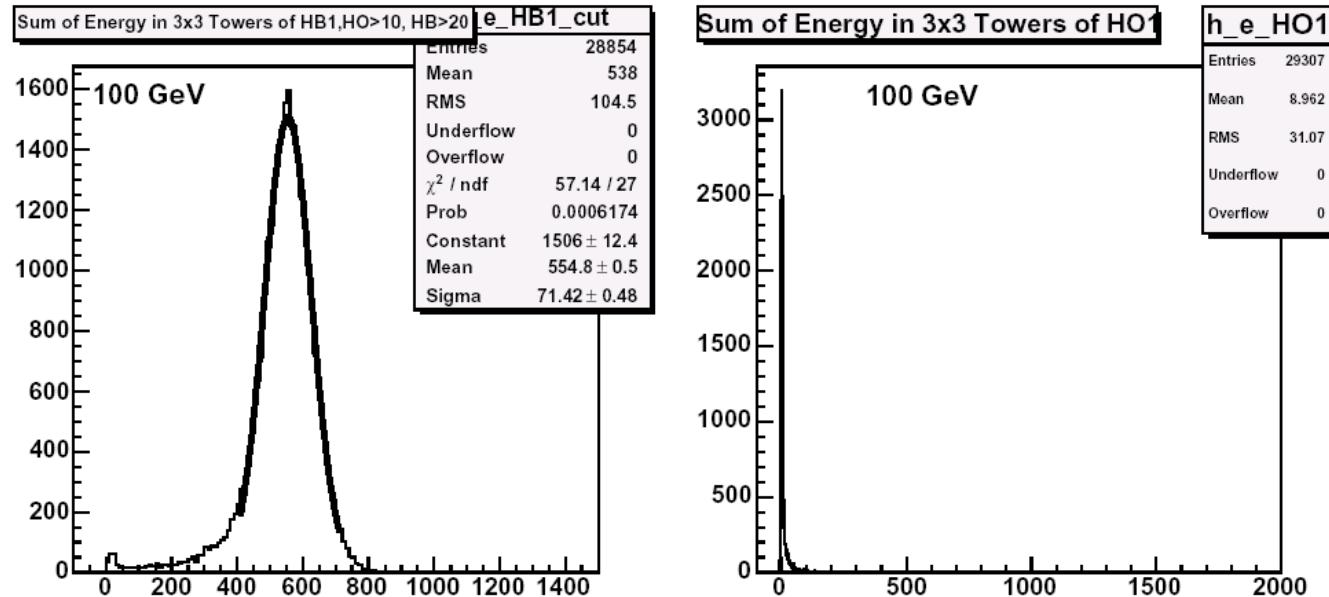


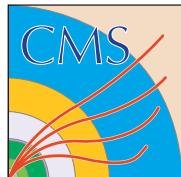
HB+HO(3), HB>20, HO>10
(min. RMS/Mean)





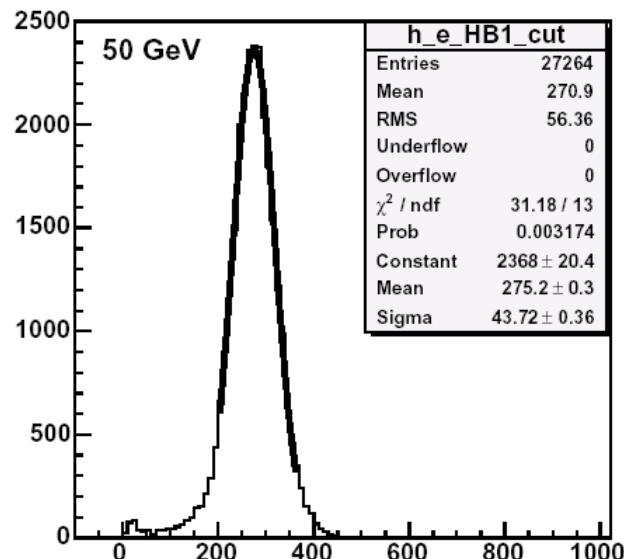
HB1+HO 100GeV



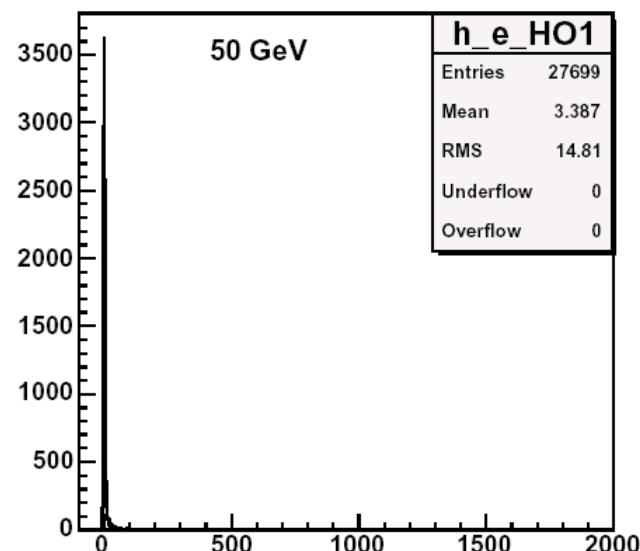


HB1+HO 50GeV

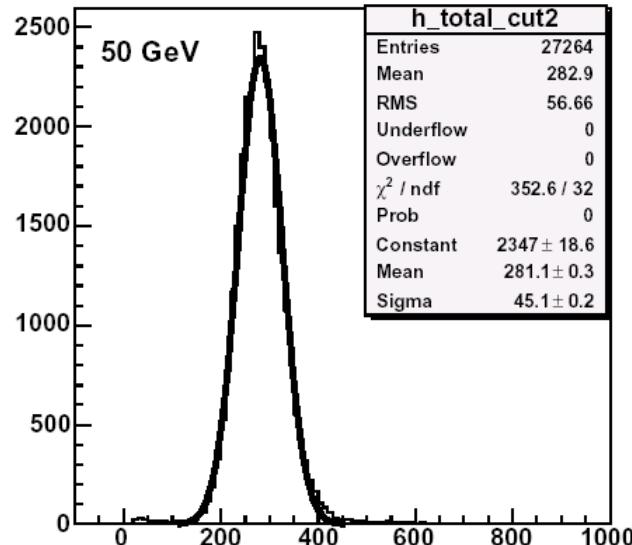
Sum of Energy in 3x3 Towers of HB1,HO>10, HB>20



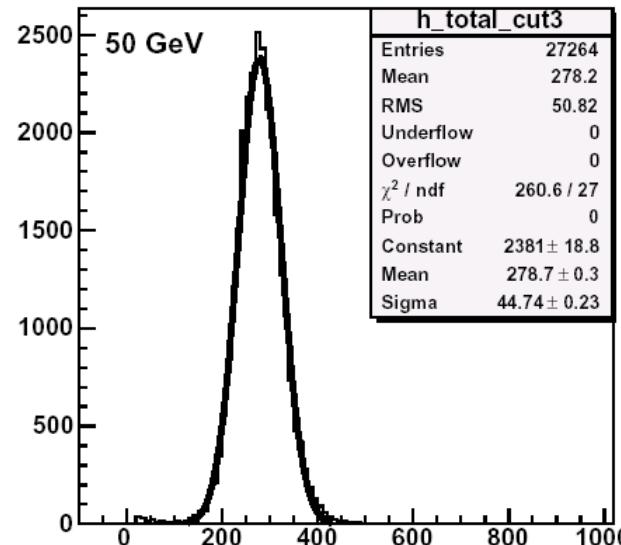
Sum of Energy in 3x3 Towers of HO1

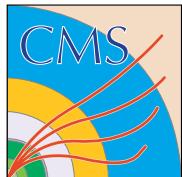


HB+HO(2), HB>20, HO>10
(fitting p_T'x)



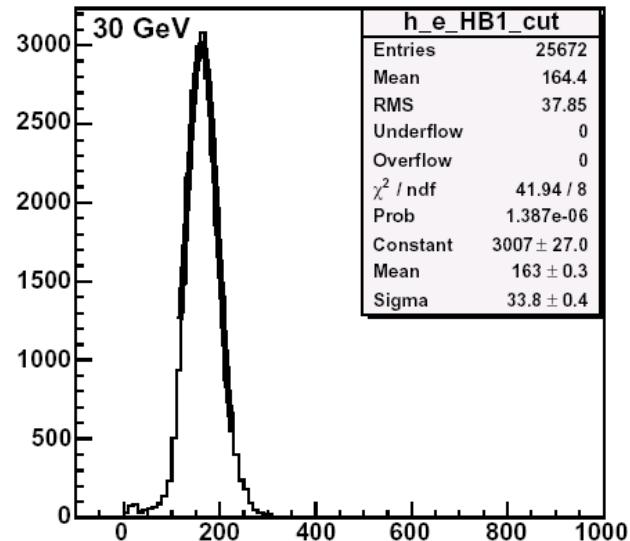
HB+HO(3), HB>20, HO>10
(min. RMS/Mean)



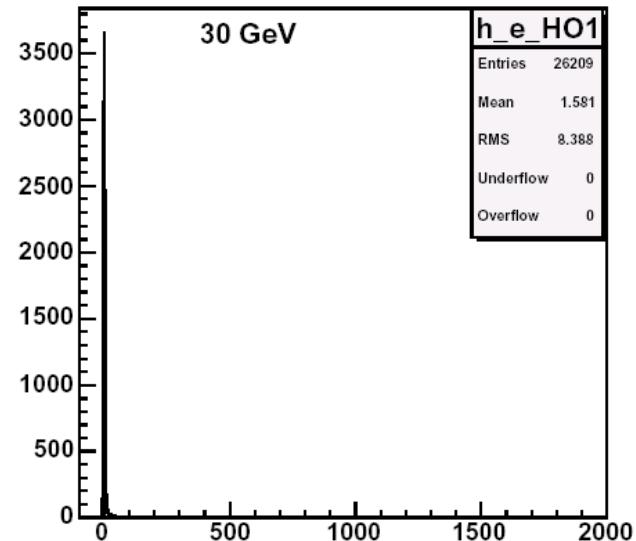


HB1+HO 30GeV

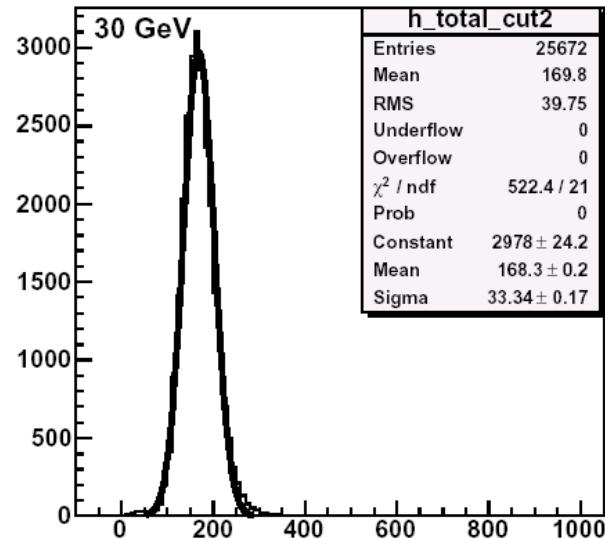
Sum of Energy in 3x3 Towers of HB1, HO>10, HB>20



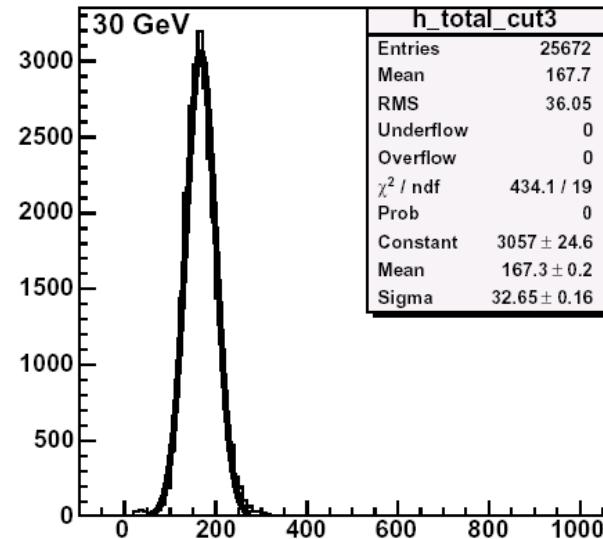
Sum of Energy in 3x3 Towers of HO1



HB+HO(2), HB>20, HO>10
(fitting with p*x)

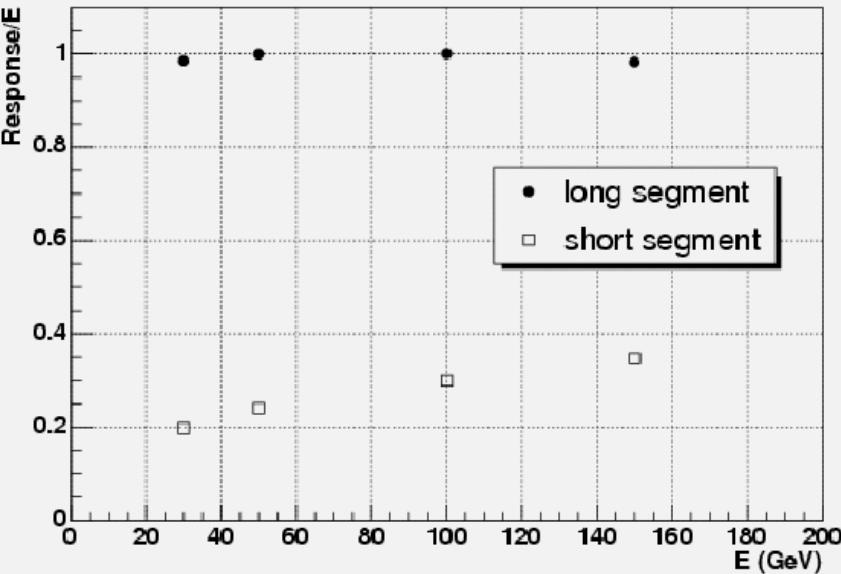
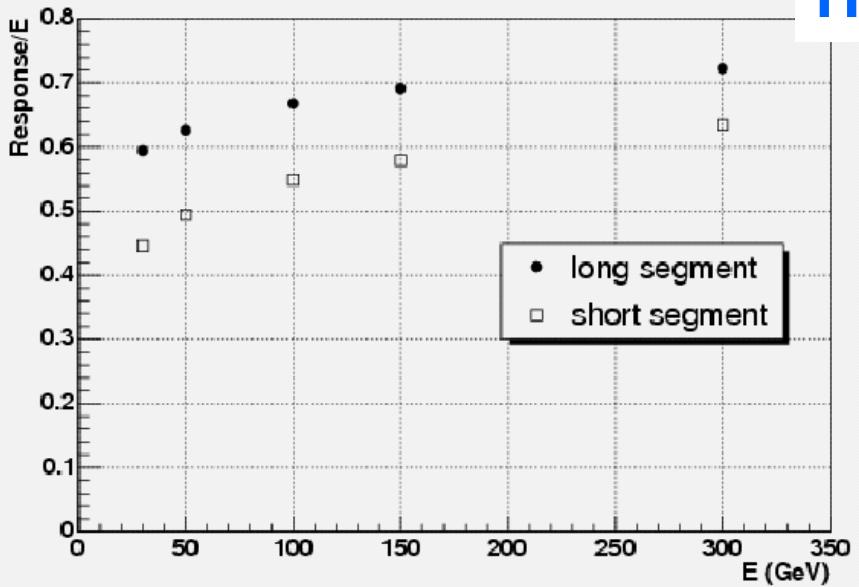
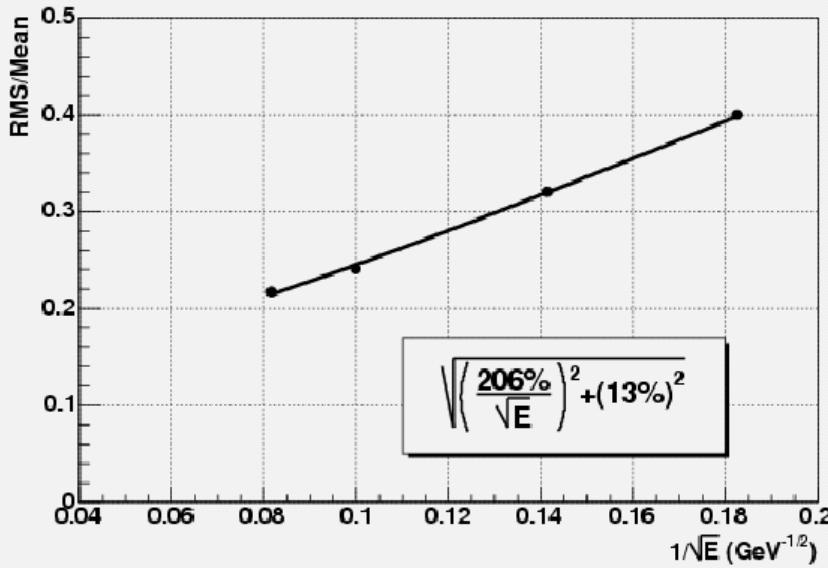
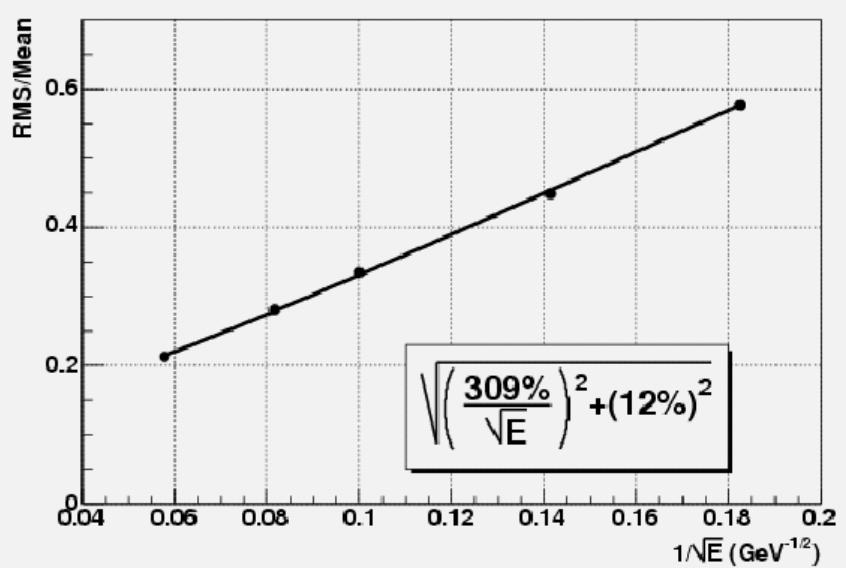


HB+HO(3), HB>20, HO>10
(min. RMS/Mean)

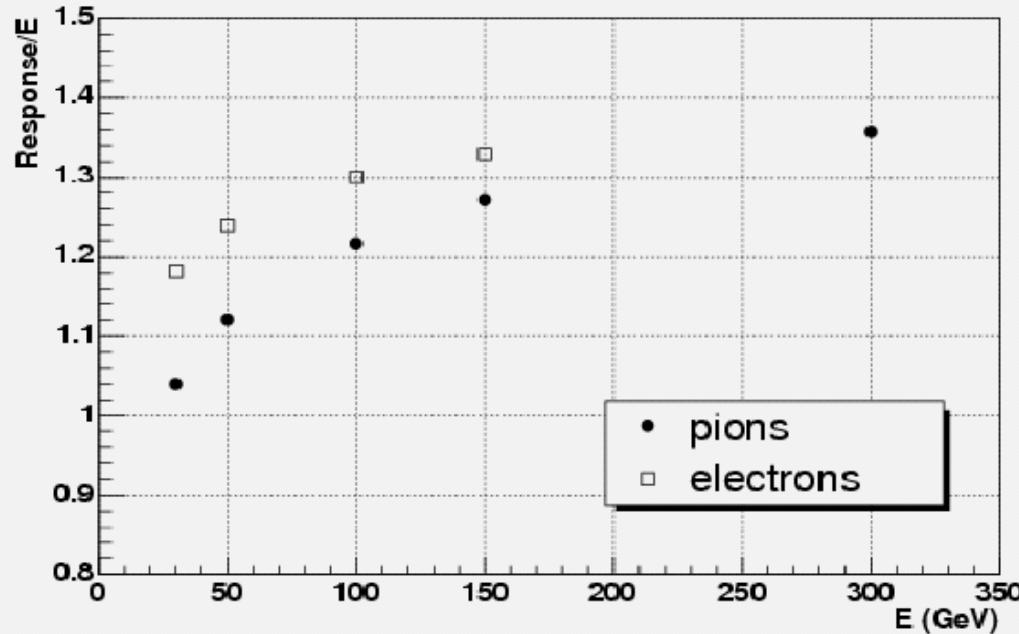




HF

Response to electrons**Response to pions****Electron energy resolution****Pion energy resolution**

Response (long+short)



HF: Long + Short

π/e : large improvement

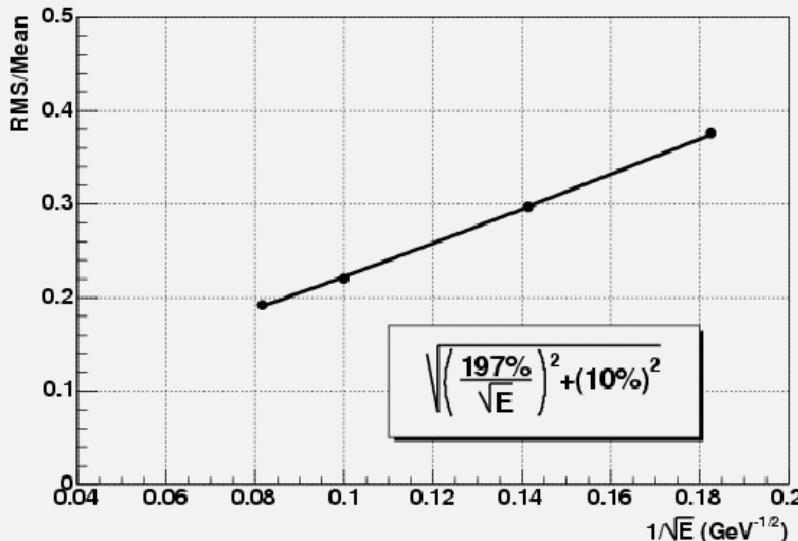
$$(0.6-0.7)_L \rightarrow (0.86-1.0)_{L+S}$$

rms/E: Minor improvement

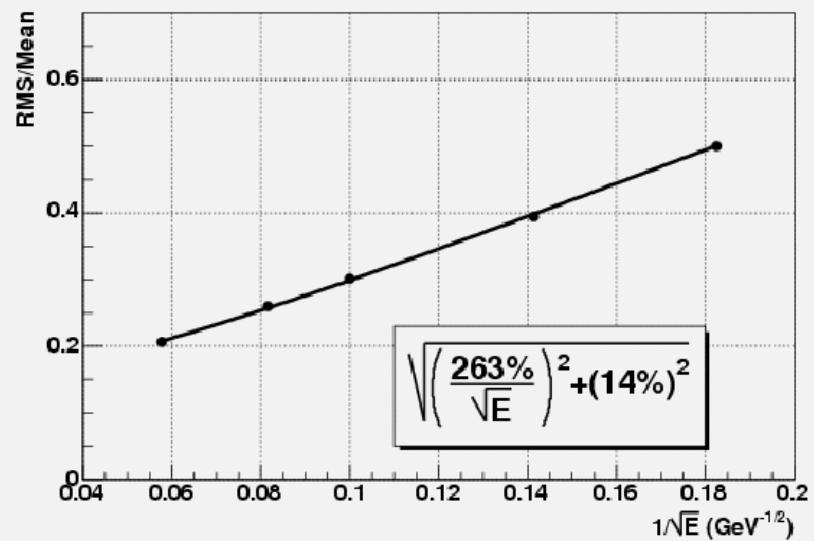
24% \rightarrow 22% for 100GeV electron

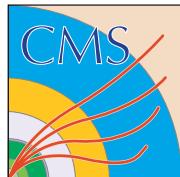
33% \rightarrow 30% for 100GeV pion

Electron energy resolution (long+short)



Pion energy resolution (long+short)





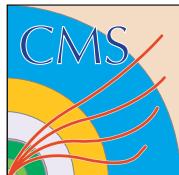
HF: Source/Beam(100GeV e)

*leakage corrections are used for beam coeff,
towers 12, 13 are excluded
corrections for “geometrical” corrections are applied*

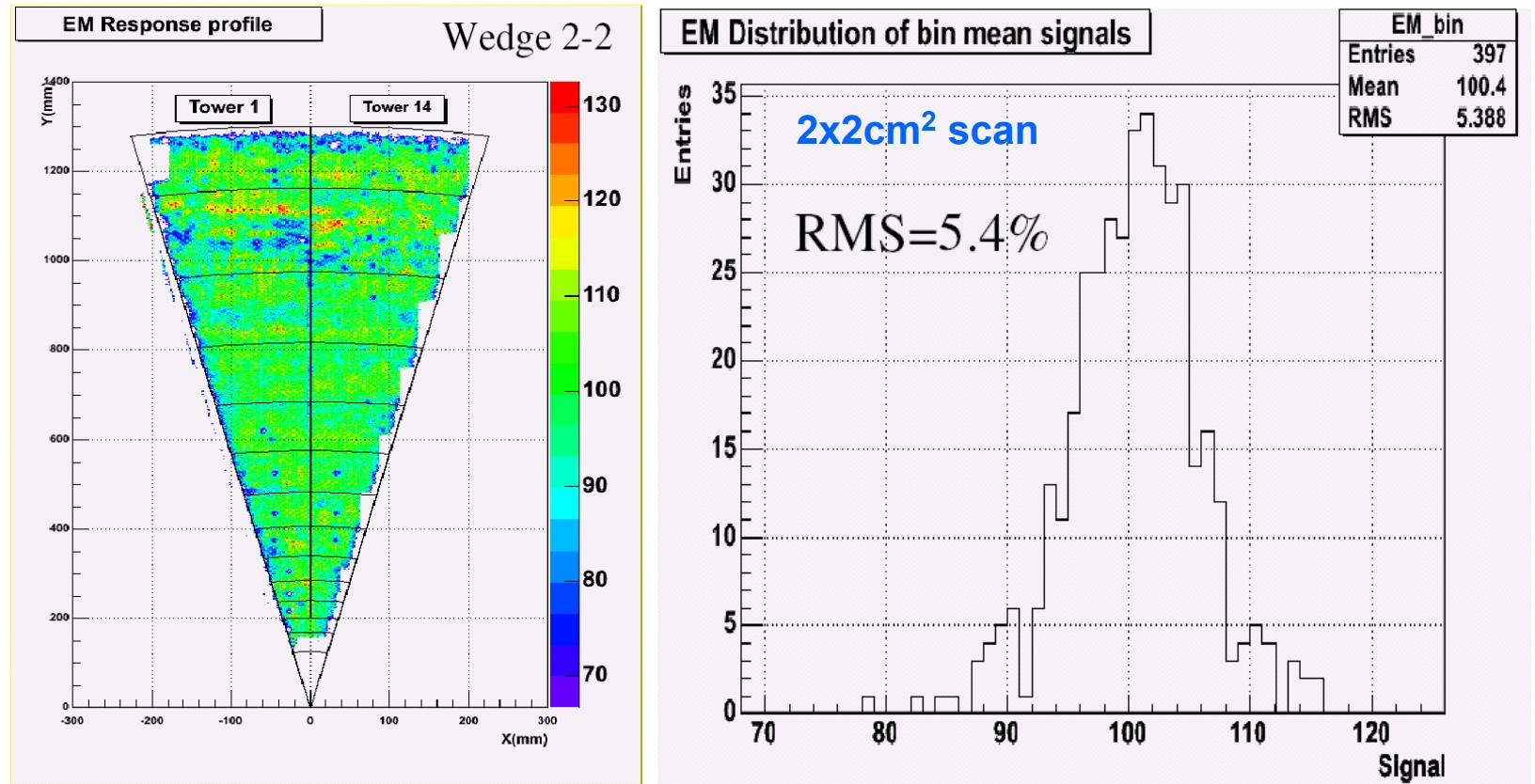
1350V

	EM		HAD	
	mean	RMS	mean	RMS
Wedge 2.02	0.98	0.032	0.99	0.050
Wedge 2.04	1.00	0.040	0.96	0.051
Wedge 2.06	0.98	0.033	1.05	0.047
Wedge 2.13	0.99	0.034	1.02	0.041
Wedge 2.14	1.03	0.035	0.99	0.025

A.Krokhutine, 17-March-05, CMS Week

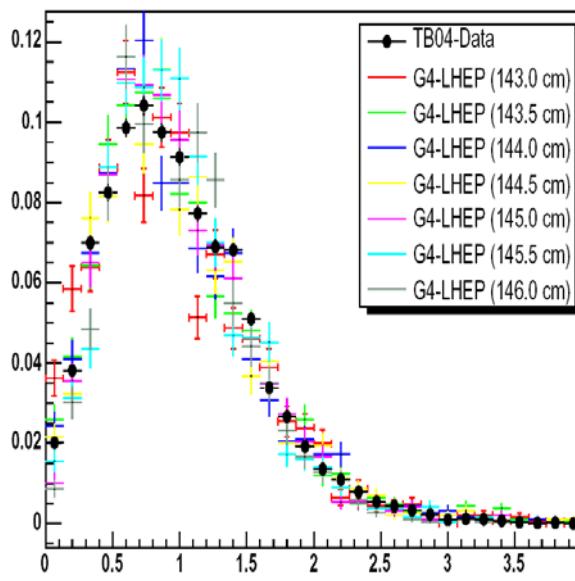
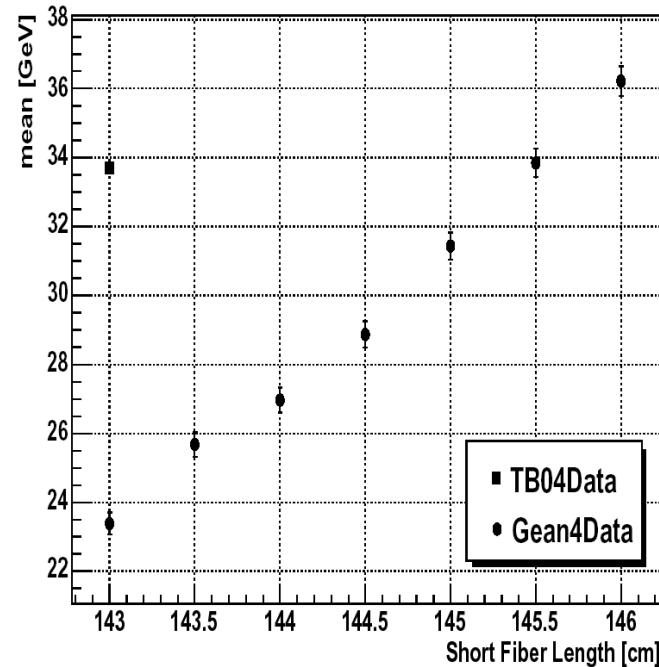
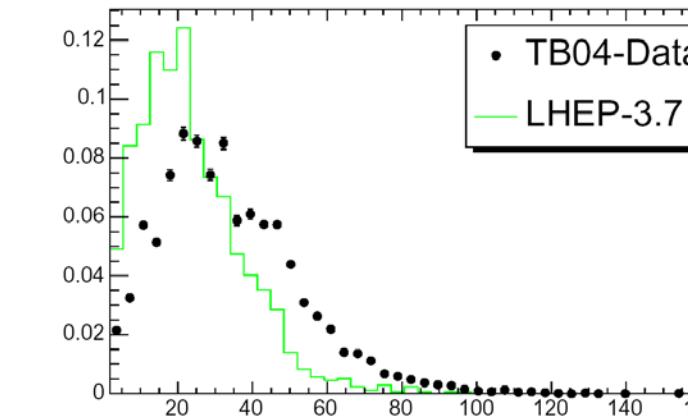


HF Uniformity



Variations (RMS) of the average response over the HF surface at a medium scale (2cm) are ~5% for electrons and ~3% for pions which contribute to the constant term in the energy resolution for single particles.

100 GeV e- signal in HF short fiber.

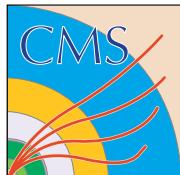


Length (cm)	mean (GeV)	Δ mean (GeV)	Prob. of the Test
143.0 (TB04)	33.69	0.13	1.0000
143.0 (LHEP)	23.39	0.32	0.0003
143.5 (LHEP)	25.68	0.36	0.0497
144.0 (LHEP)	26.97	0.36	0.0074
144.5 (LHEP)	28.87	0.38	0.5772
145.0 (LHEP)	31.43	0.39	0.6566
145.5 (LHEP)	33.85	0.41	0.0150
146.0 (LHEP)	36.21	0.42	0.0063

The Kolmogorov-Smirnov test is used for shape comparisons.



G4 Validation



GEANT4 Validation Data

Quantities:

π/e

Shape of dN/dE dist.
(resolution)

Shower profile
longitudinal
transverse

Detectors:

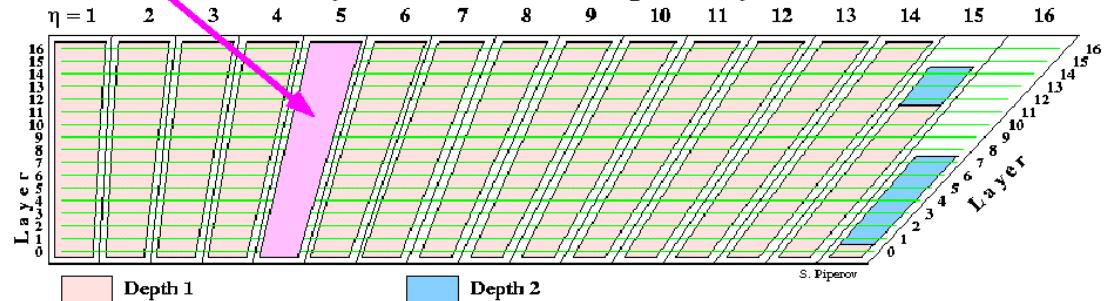
HF:

Cerenkov based

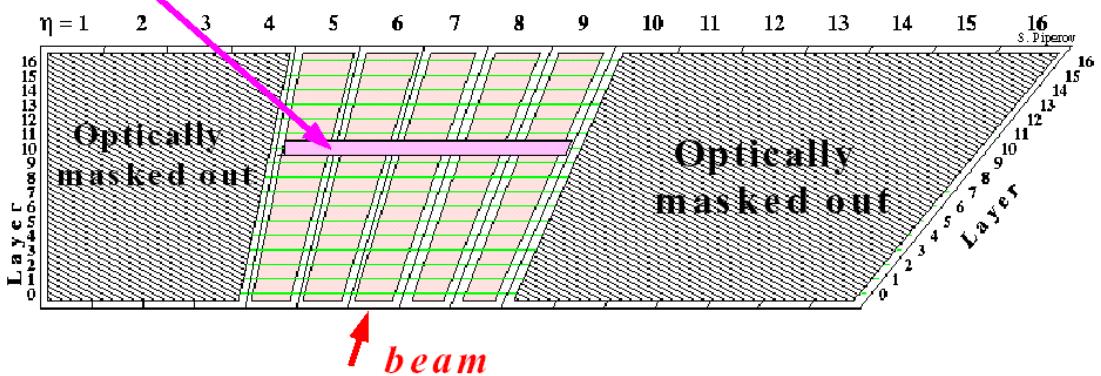
EC+HB

Scintillation based

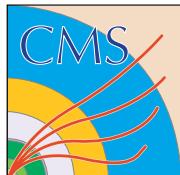
HB1: tower like – layers a summed optically



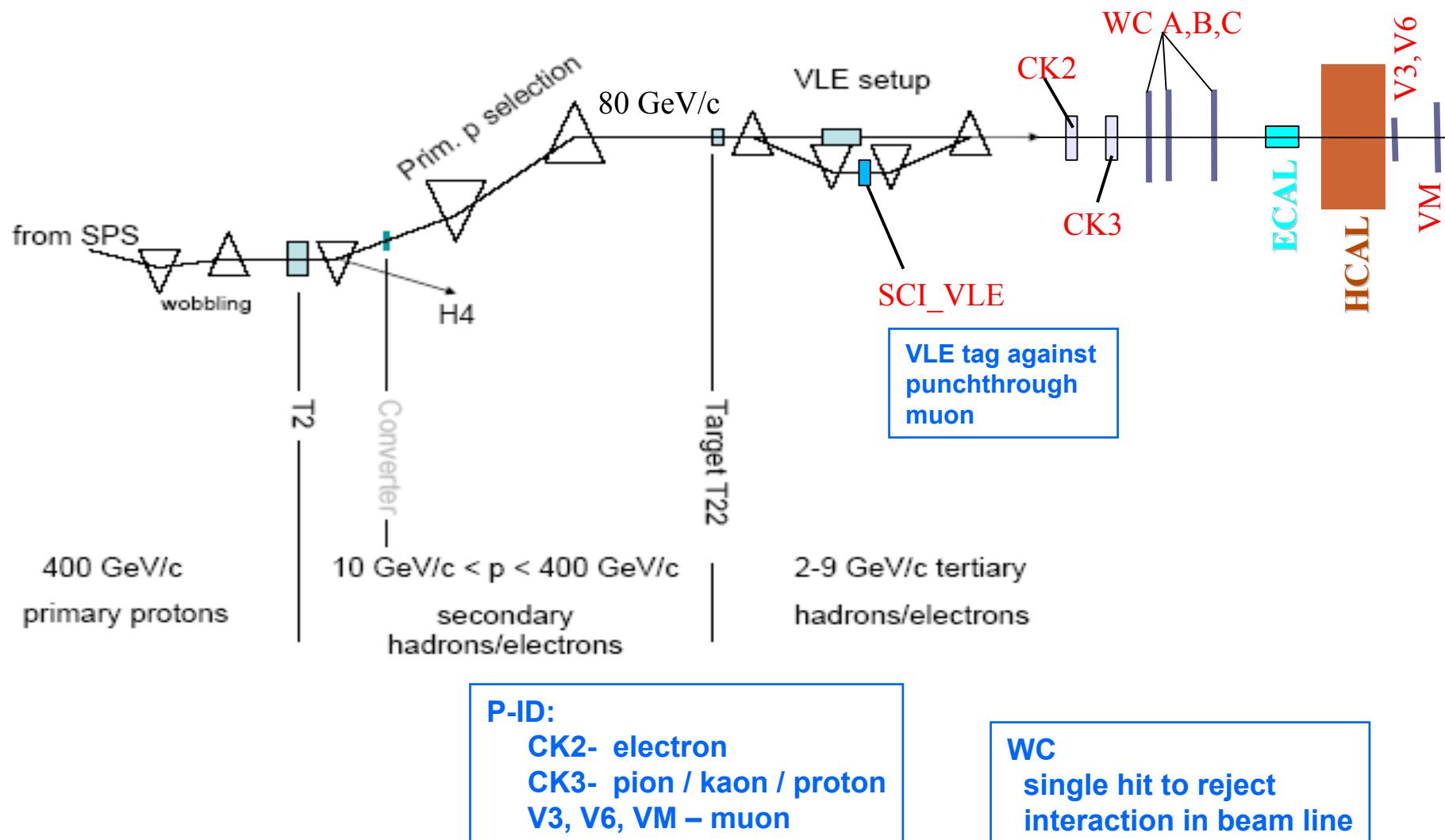
HB2: layer like – longitudinal shower profile

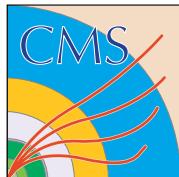


HB2 readout was reconfigured for
longitudinal shower profile study.



VLE Beam Line at H2





Data Sets

HB runs

- Very Low Energies (VLE)
 - 2,3,5,7,9 GeV mainly π^\pm beam
 - with/without ECAL
 - HB1/HB2
 - Full particle identification
- Medium Energies (MED)
 - 10,15,20 GeV e^\pm, π^\pm beam
 - with/without ECAL
 - HB1/HB2
 - Partial particle identification
- High Energies (HIGH)
 - 30,50,100,150,300 GeV
 e^\pm, π^\pm, p beam
 - with/without ECAL
 - HB1/HB2

HF runs

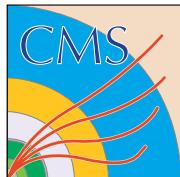
- 30,50,100,150,300 π^\pm beam
- 30,50,100,150 GeV e^\pm beam

Electron: 5-150GeV

Pion: 5-300 GeV

Proton: 5-9 GeV

(2GeV and 3GeV data exist, but a lot of junks.)



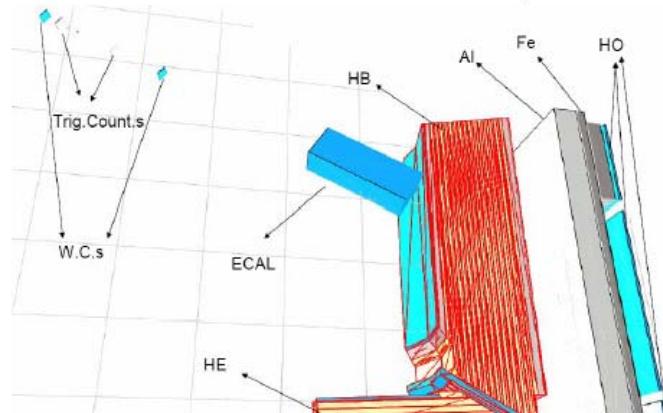
GEANT4 Simulation

Physics Lists:

- LHEP: **LEP/HEP** *parametrized* models for inelastic scattering.
- QGSP: **Quark Gluon String** model for the 'Punch-through' interactions.
- QGSC: QGSP + **Chiral** invariant phase-space decay.
- FTFP: diffractive string excitation similar to that in FRITJOF and Lund.

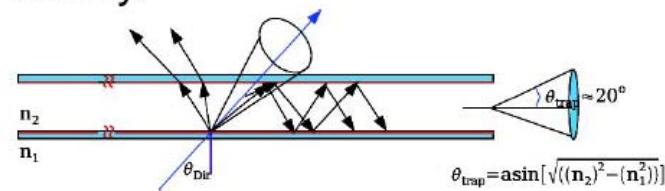
HB simulation:

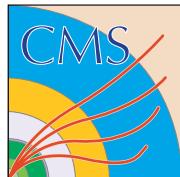
standard OSCAR TBHcal04 application with minor additions to store information about the first interaction point.



HF simulation:

standalone Geant4 with local simulation of Cherenkov light generation, trapping, transportation and PMT quantum efficiency.

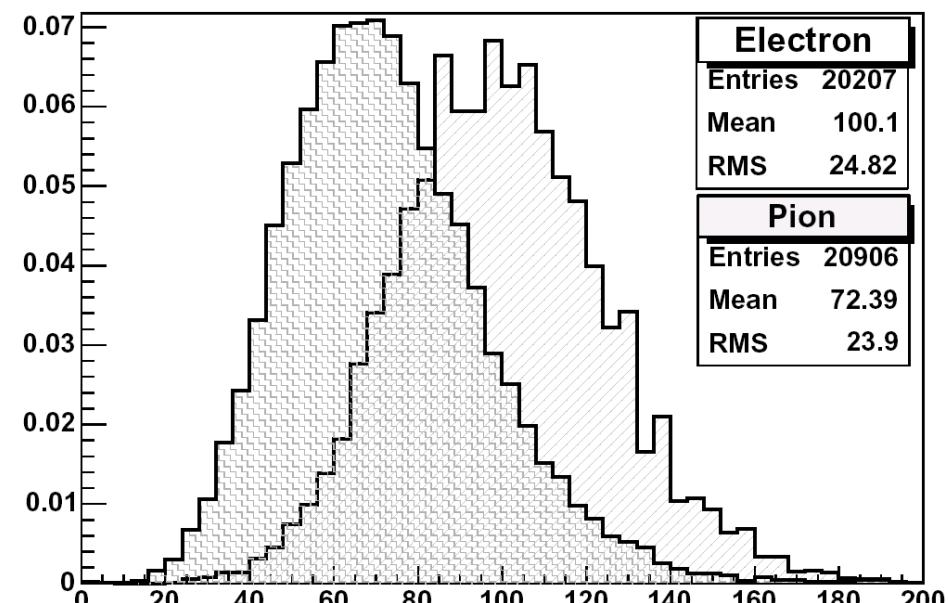
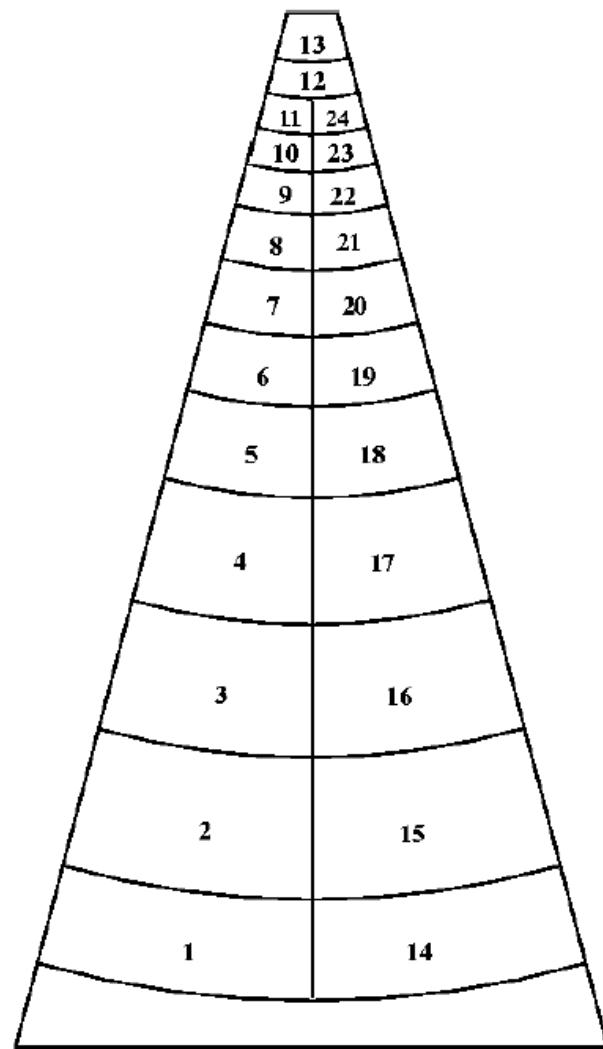




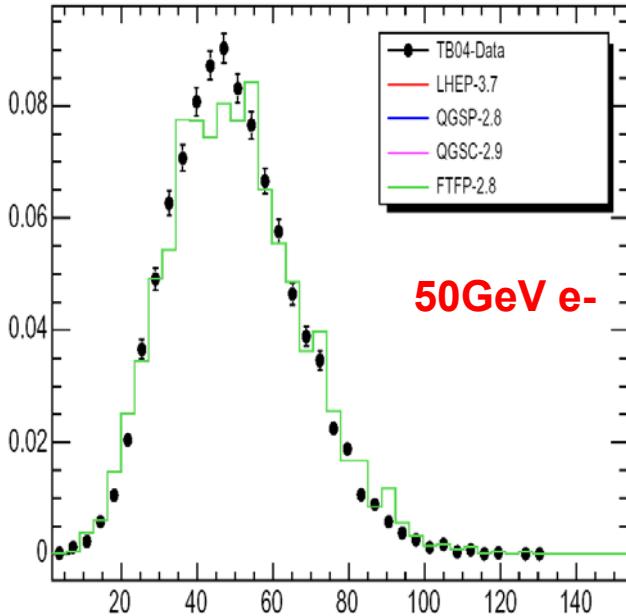
HF

Wedge 2.13 Long Fiber Section (EM)

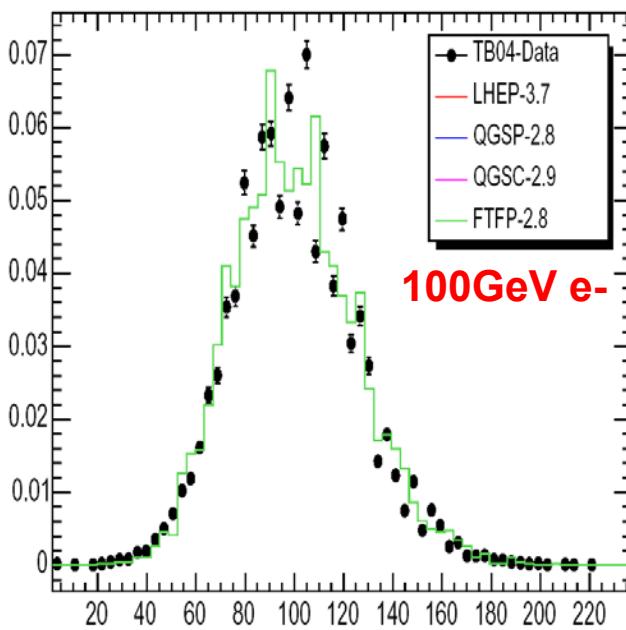
100 GeV electrons and pions



$$\text{Pion/elec} = 0.72$$

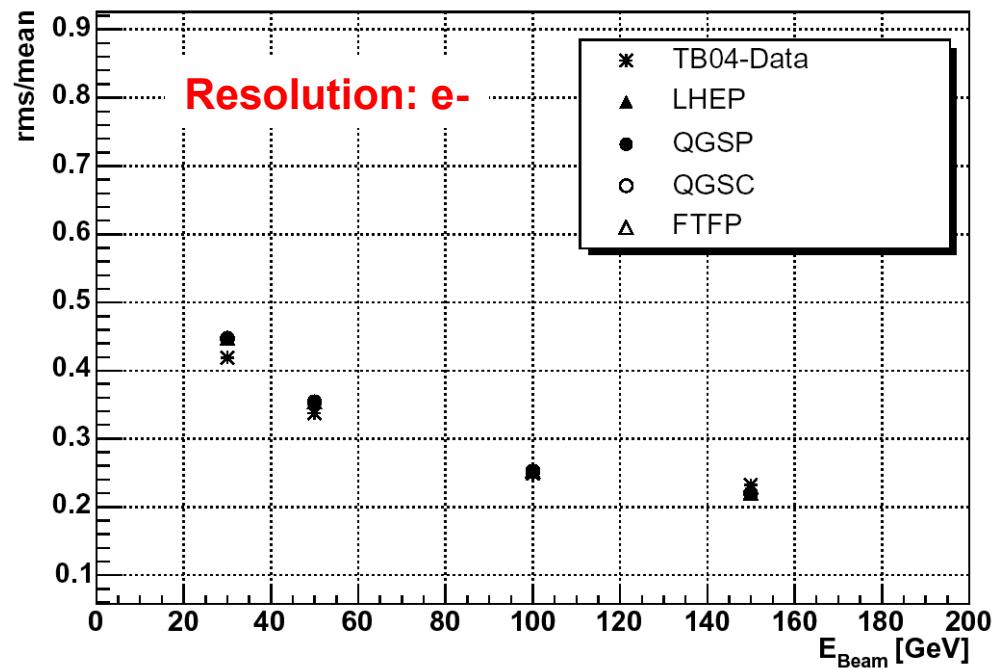


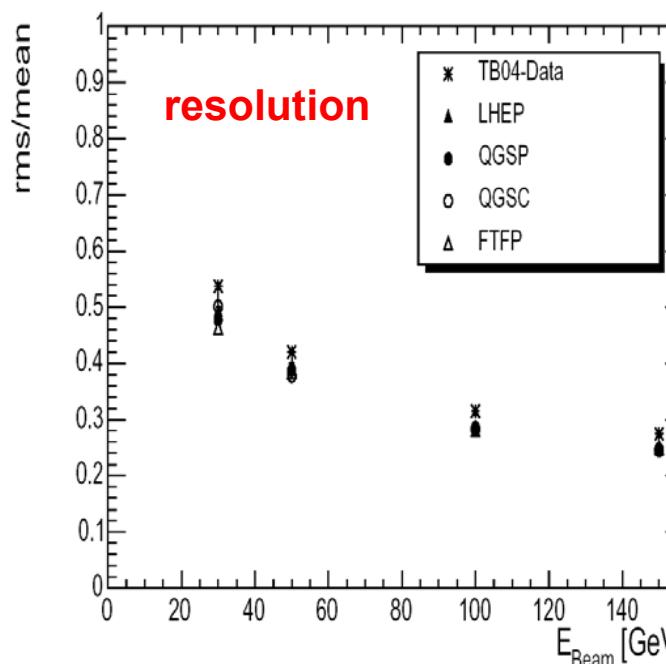
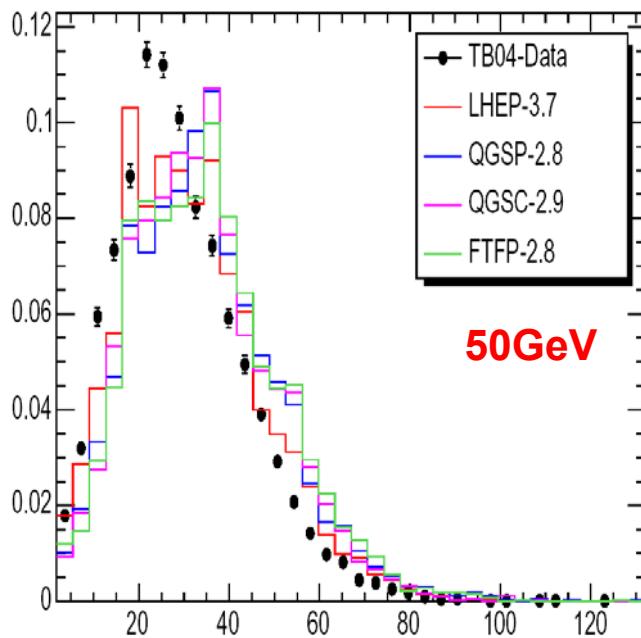
HF (Long)



Electrons

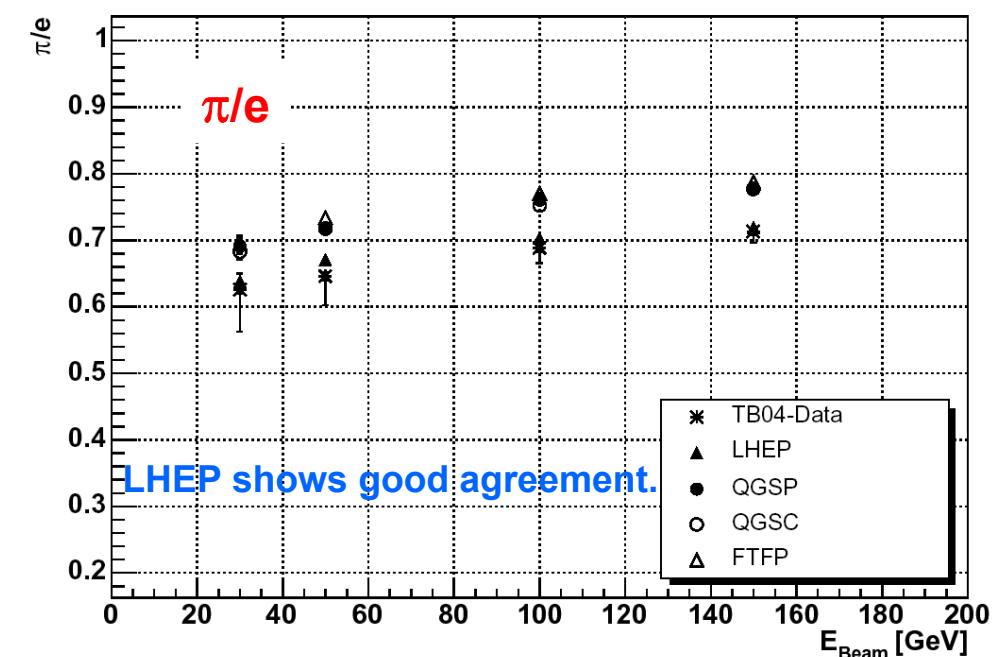
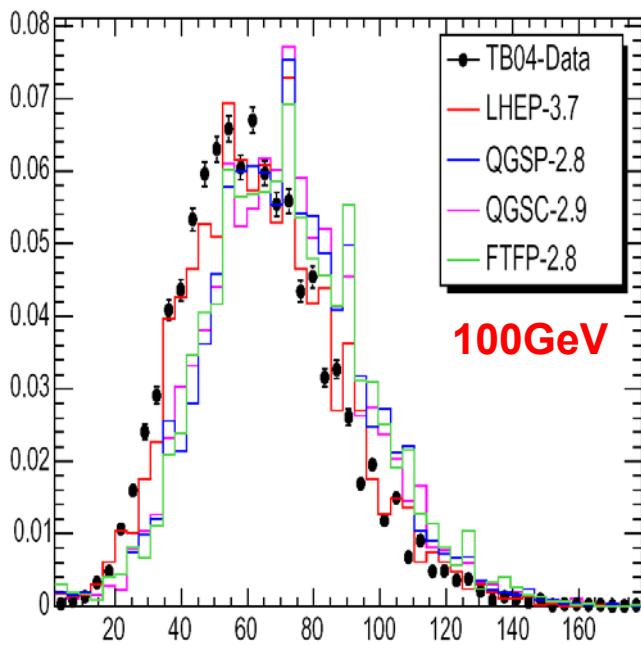
Very detailed simulation with G4 reproduces electron signal very well.





HF (Long)

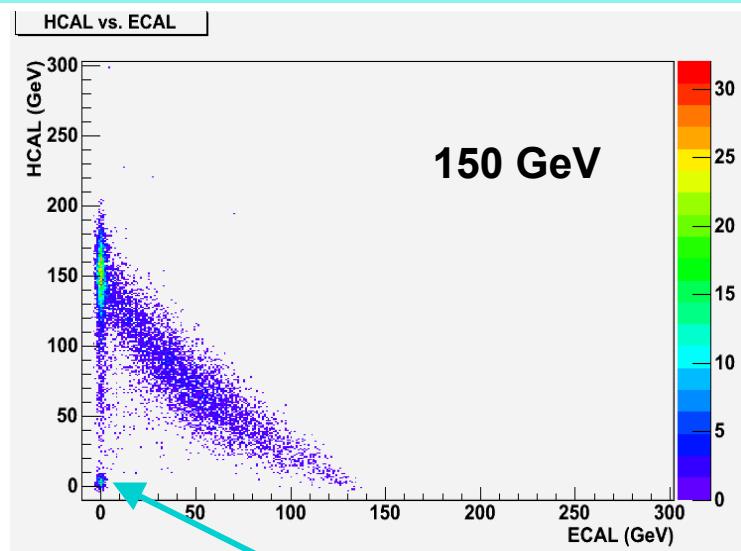
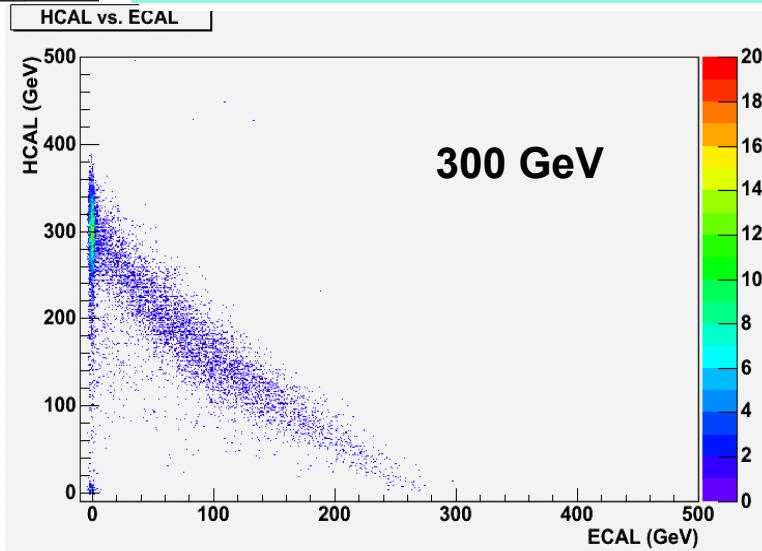
pi-



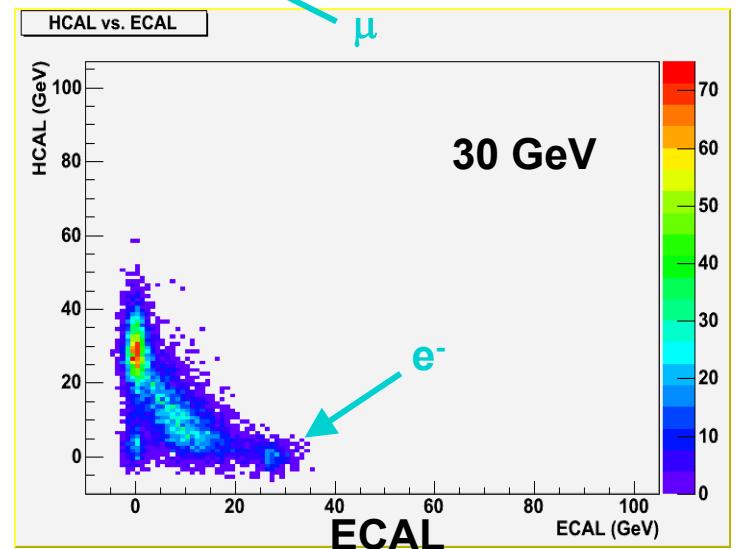
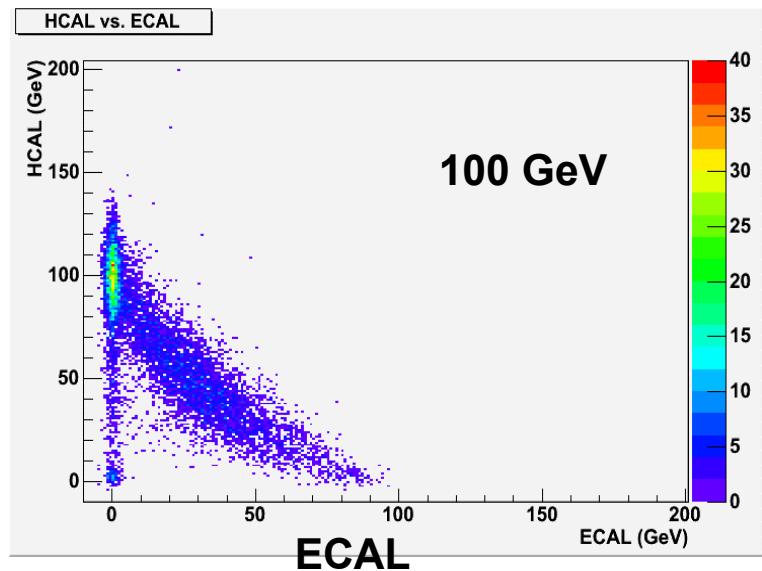


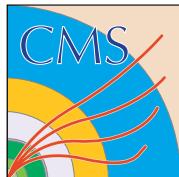
EC+HB High Energy Data (π^-)

HB

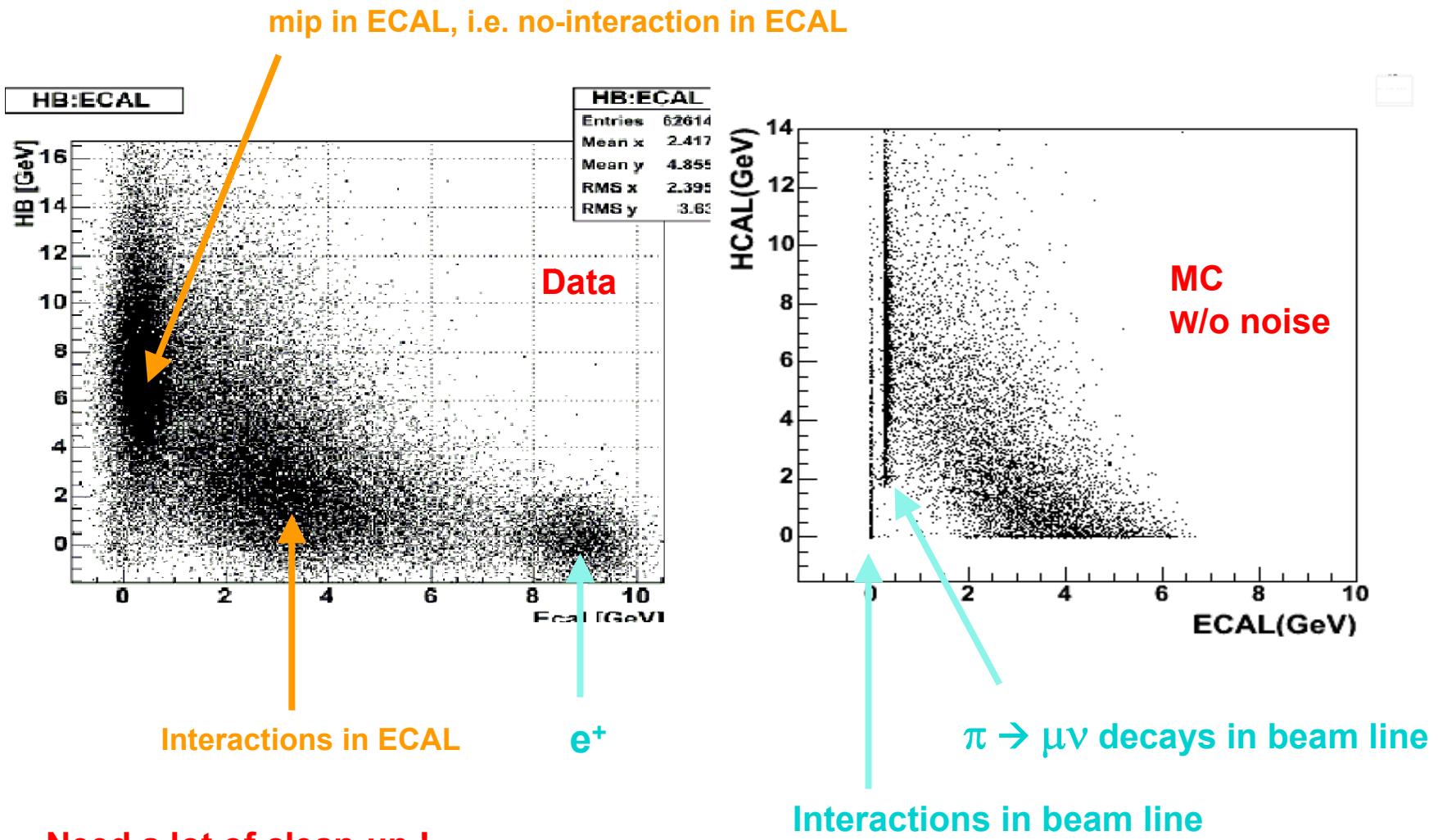


HB





9 GeV pi+ beam

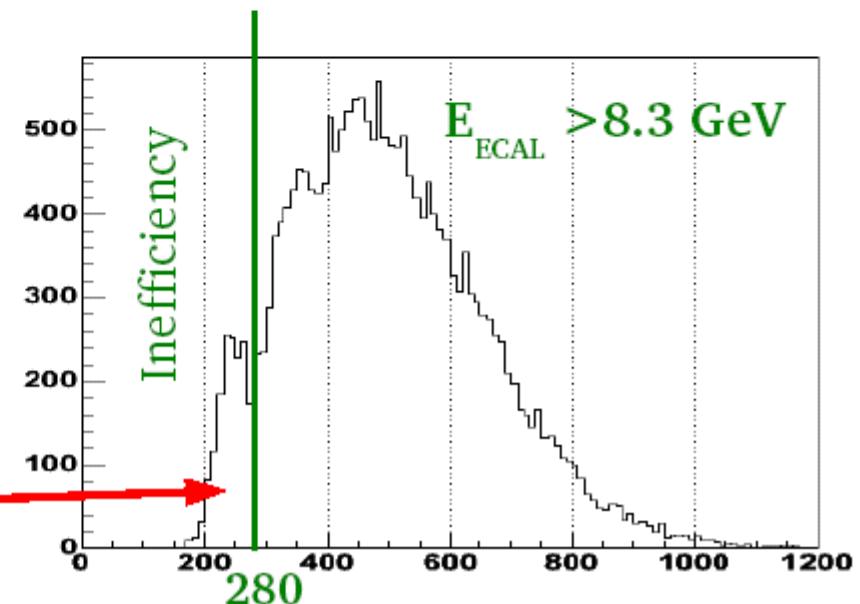
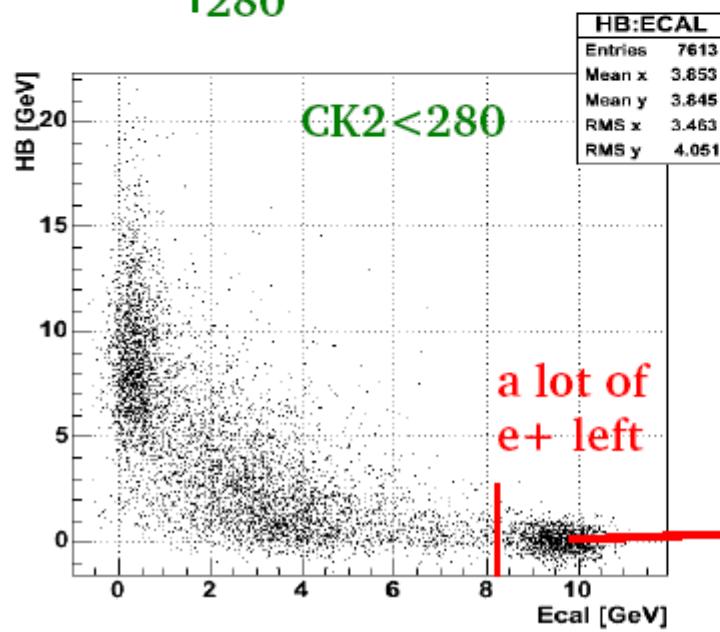
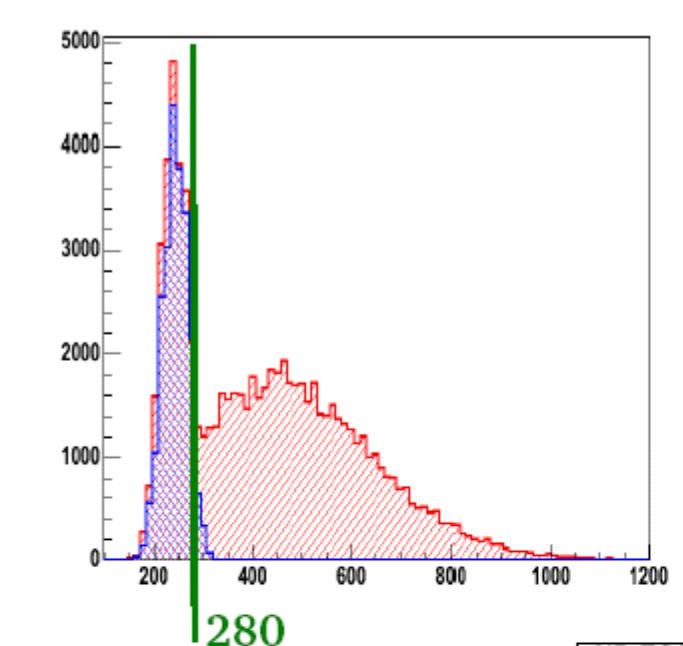


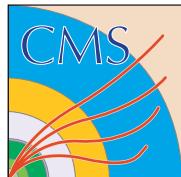
P-ID with CK2 (cont.)

$\pi + 10 \text{ GeV}$ tune

CK2 Eff. $\approx 92\%$

Electron identification

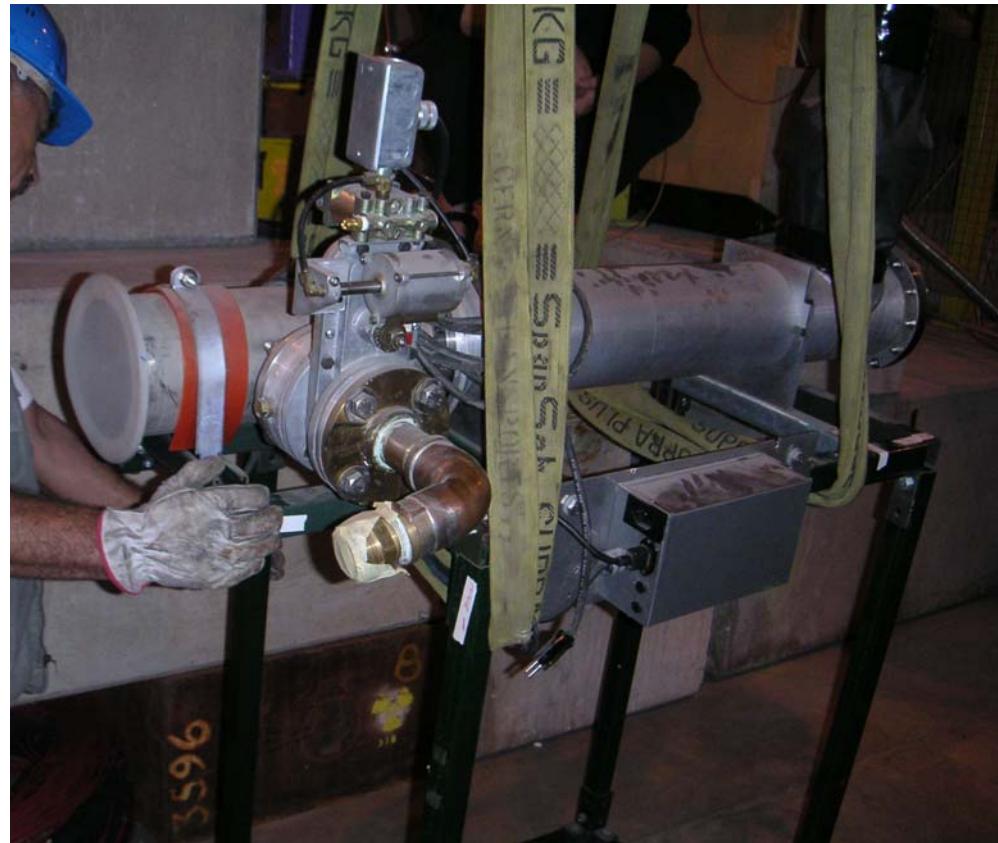




P-ID with Cerenkov Counter 3 (CK3)

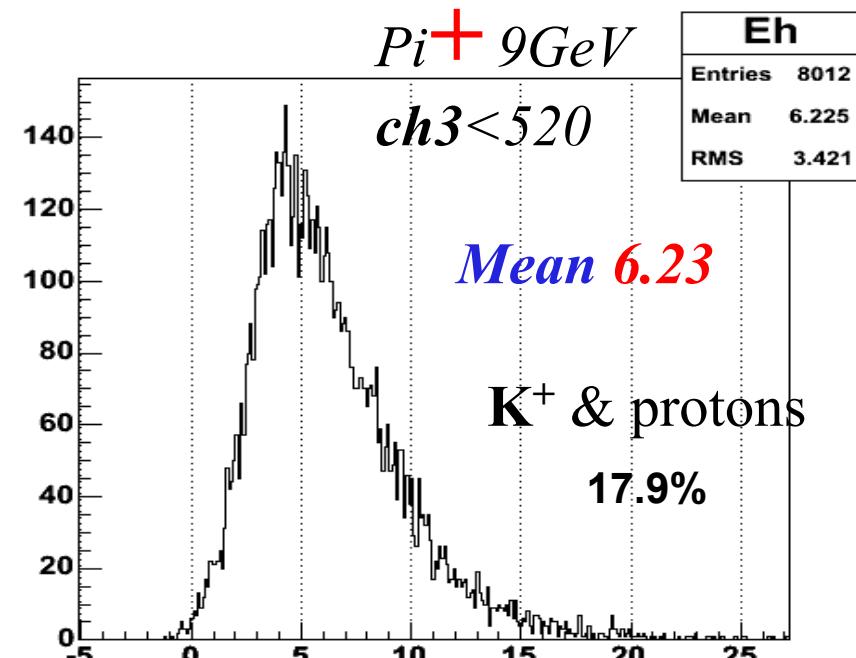
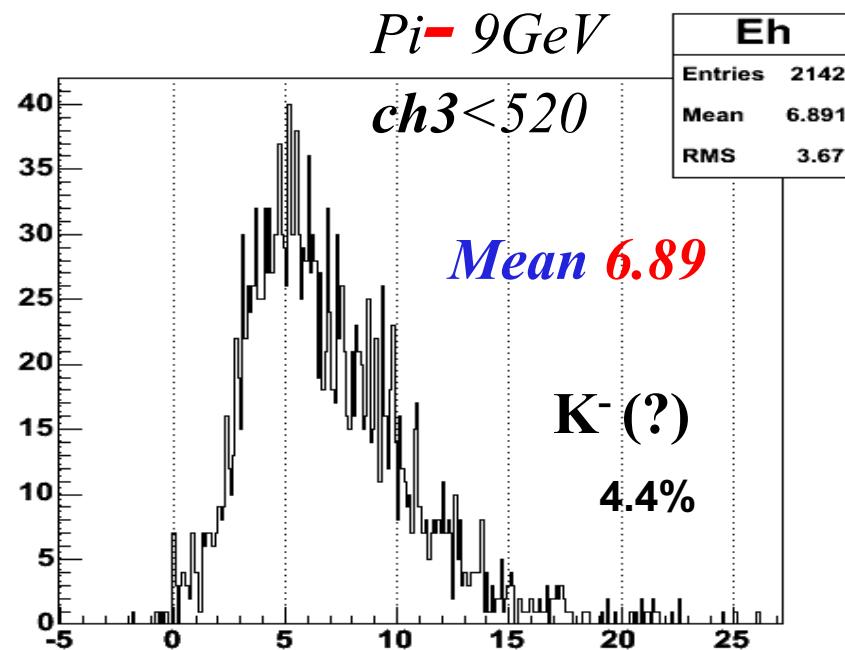
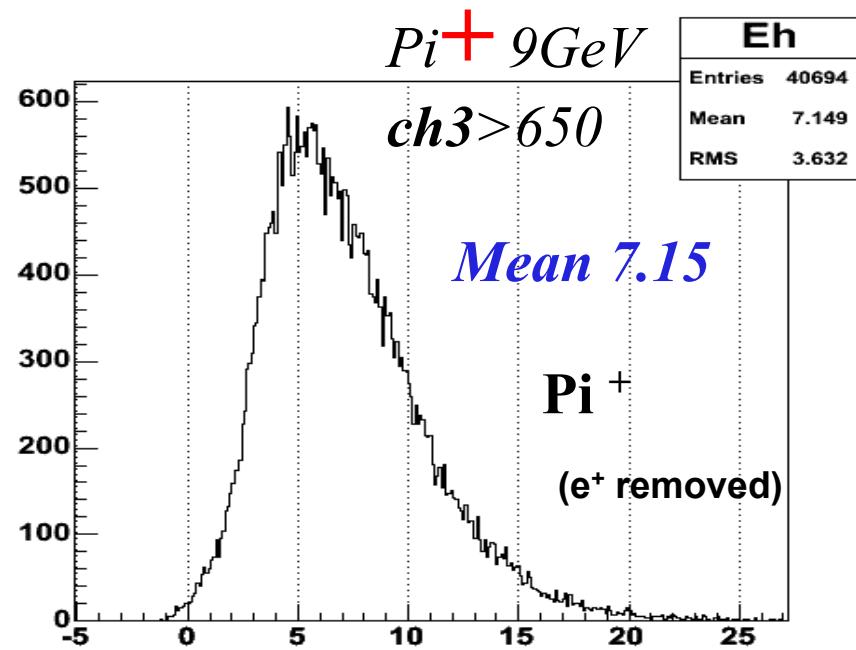
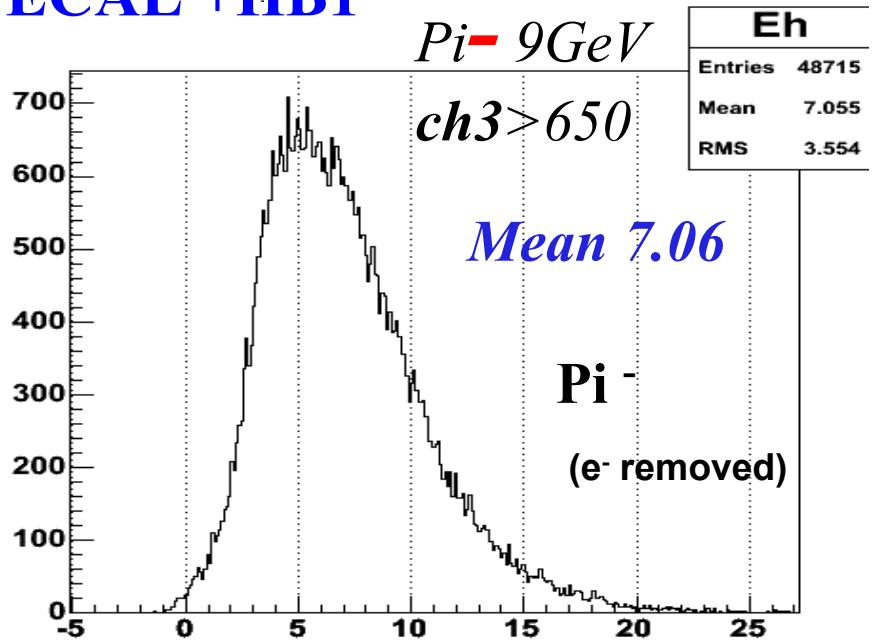
The momentum thresholds
for the range of dn are:

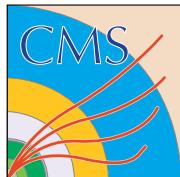
dn *E-6	P(π)	P(μ)	P(p)	P(K)
2432	2.0	1.51	13.5	
1557	2.5	1.89	16.8	
1082	3.0	2.27	20.2	
795	3.5	2.65	23.5	12.35
609	4.0	3.03	26.9	
481	4.5	3.41	30.3	
390	5.0	3.79	33.6	



Freon Cerenkov Counter

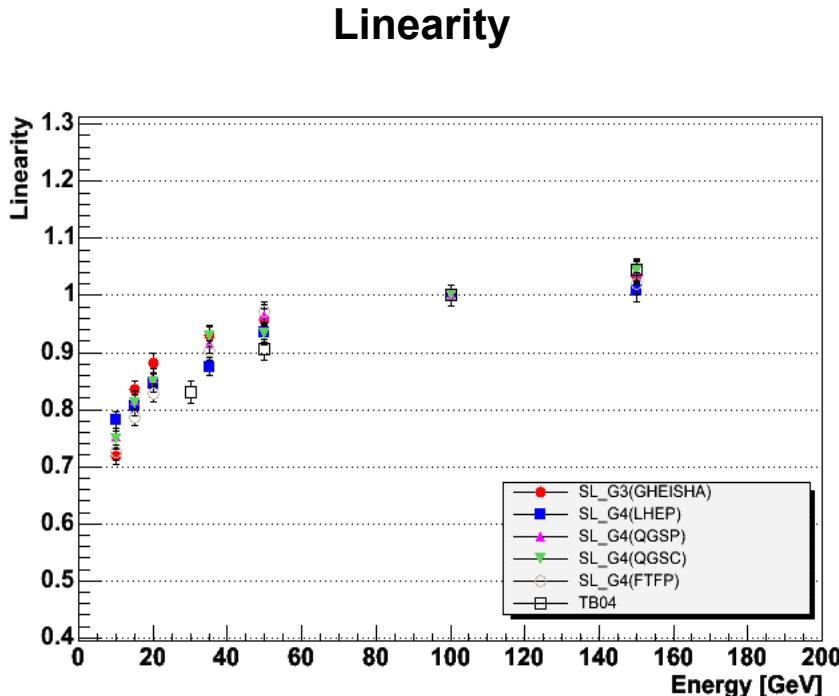
ECAL +HB1



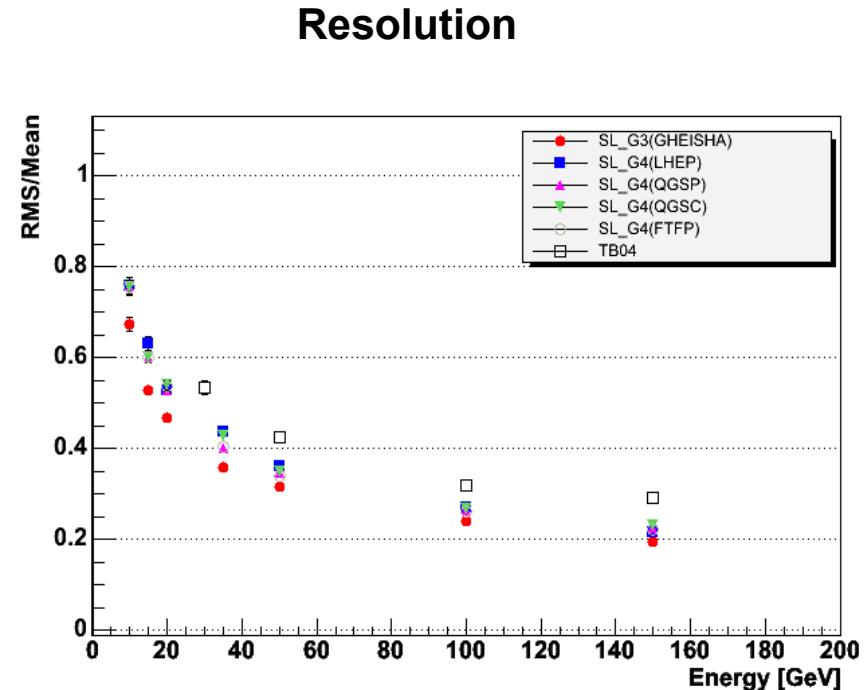


HF Shower Library and TB2004

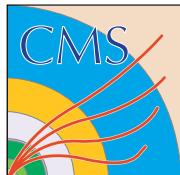
New HF Shower Library:
detailed simulation from cerenkov light generation to photo electron
simulation at PMT with G4.
→ Test in progress.



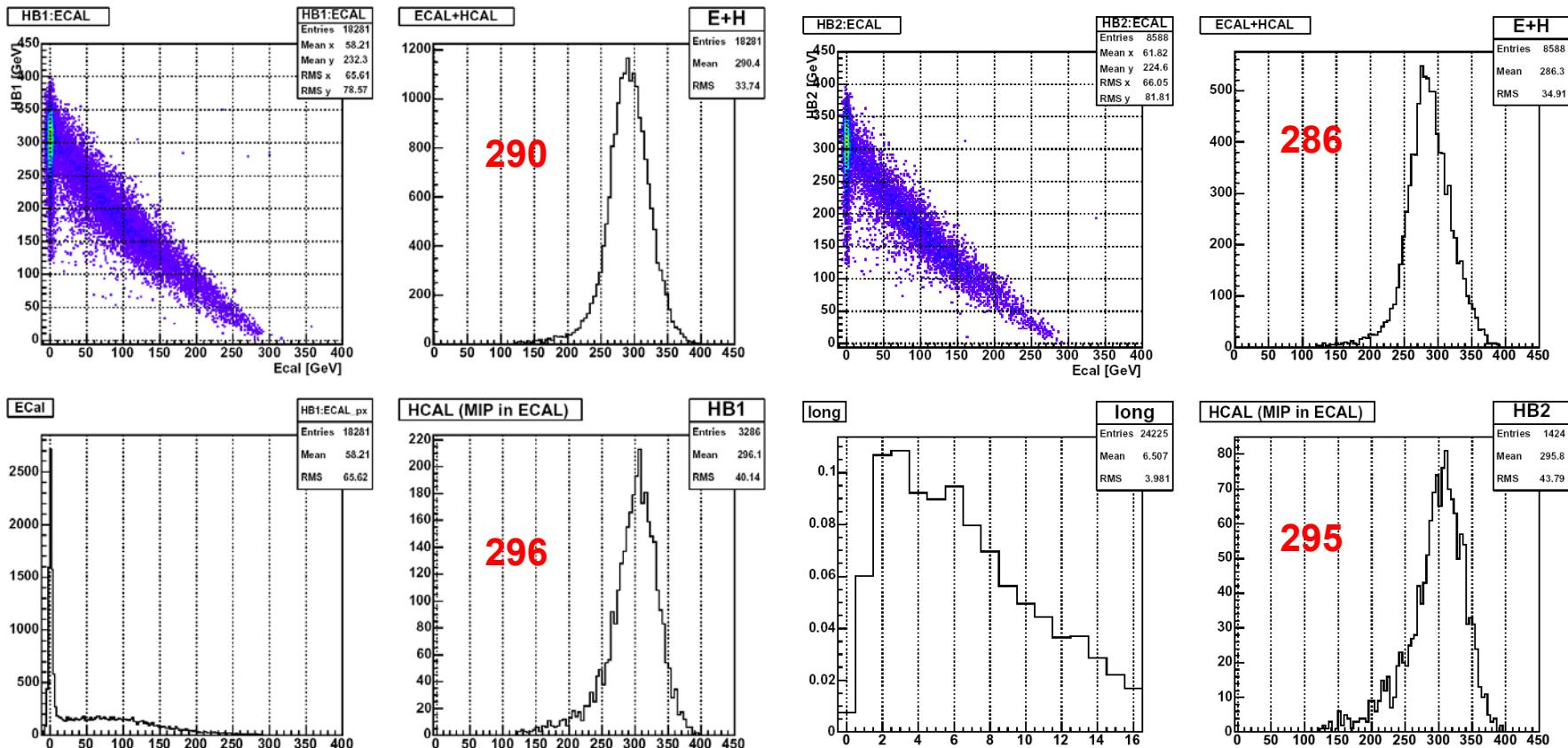
Data vs G4: ~10%

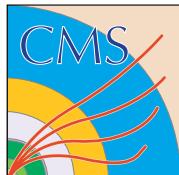


~10%

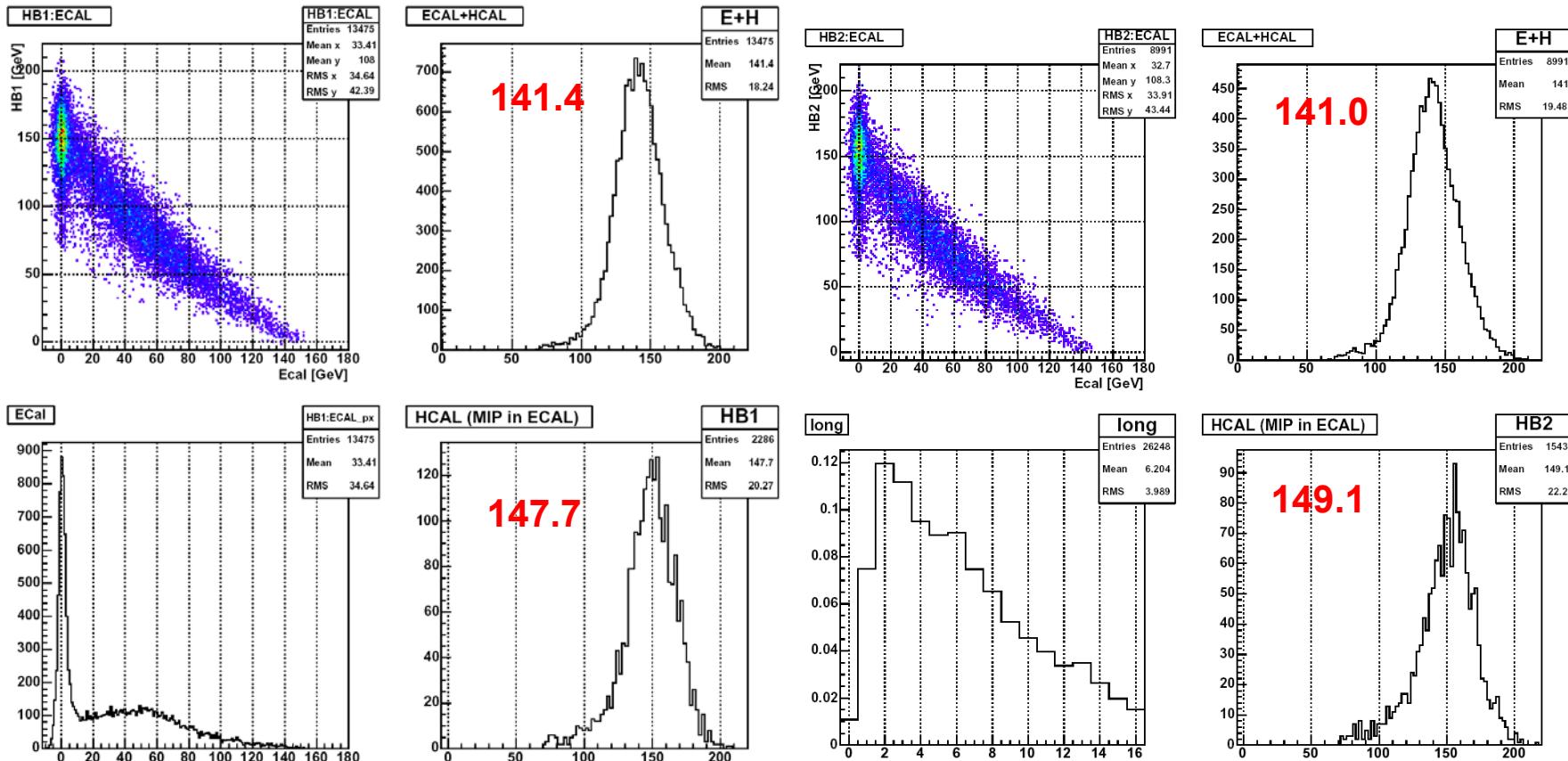


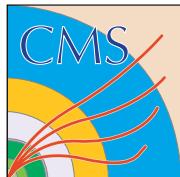
300GeV Pi-



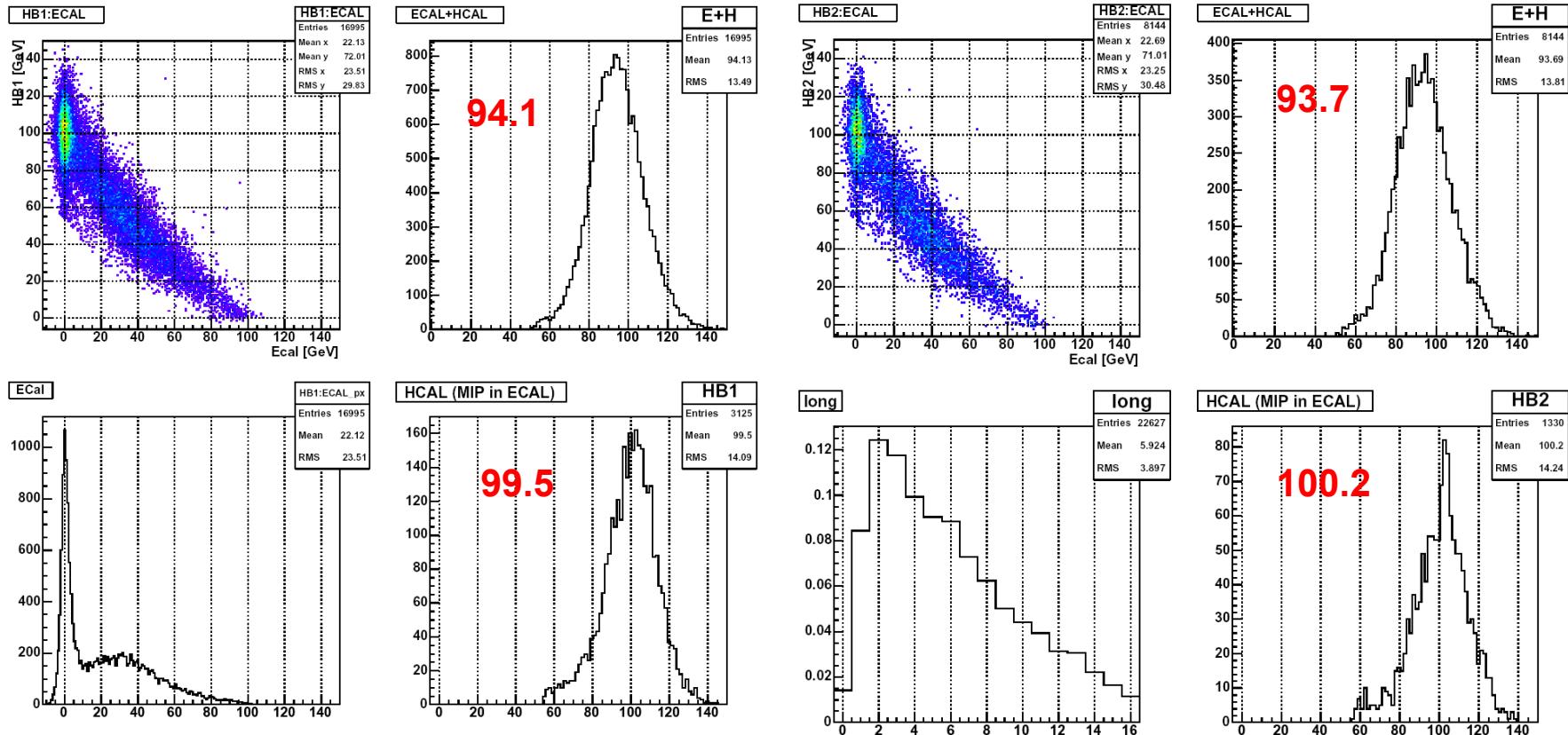


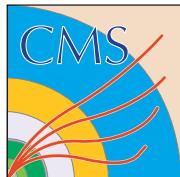
150GeV Pi-



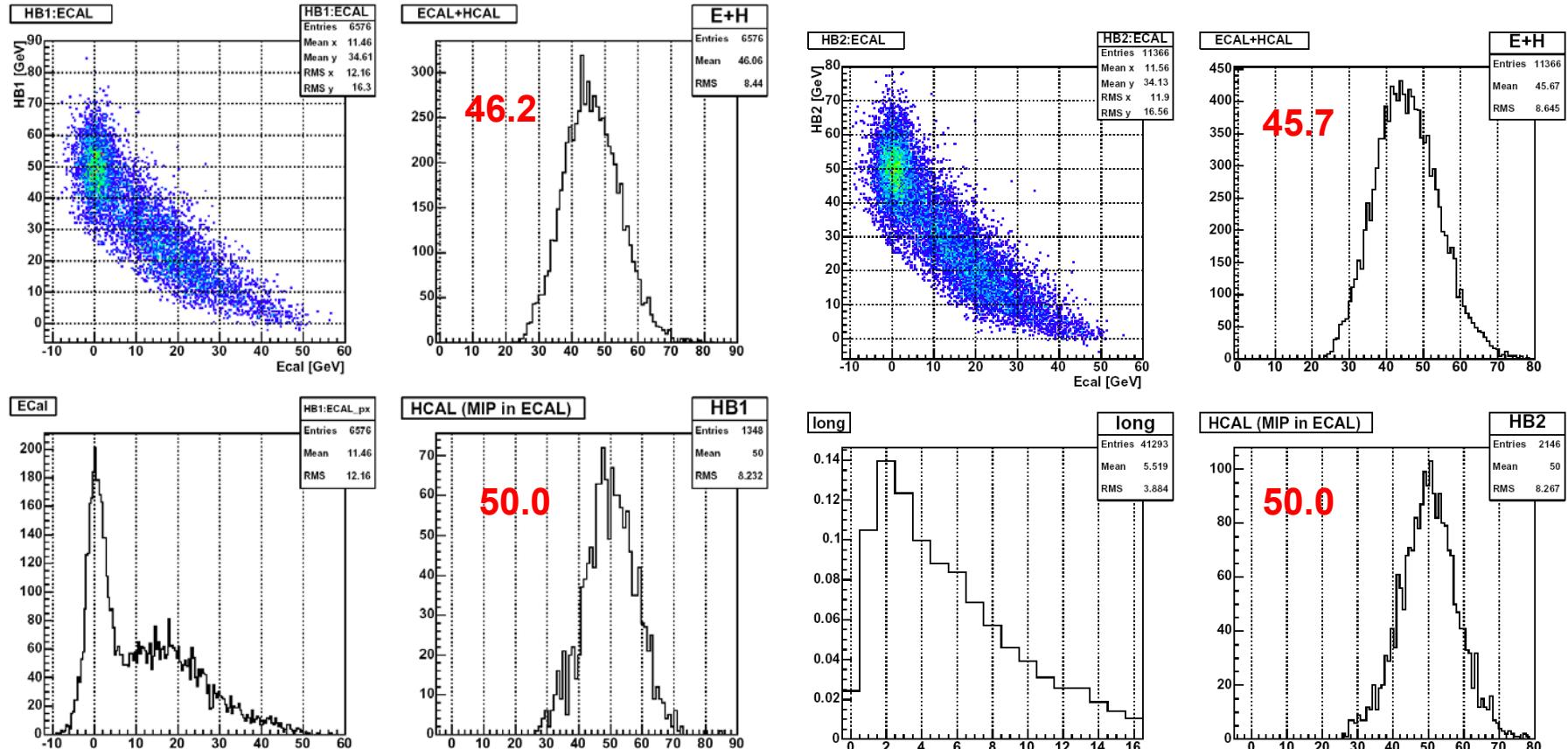


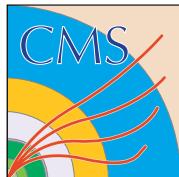
100GeV pi-



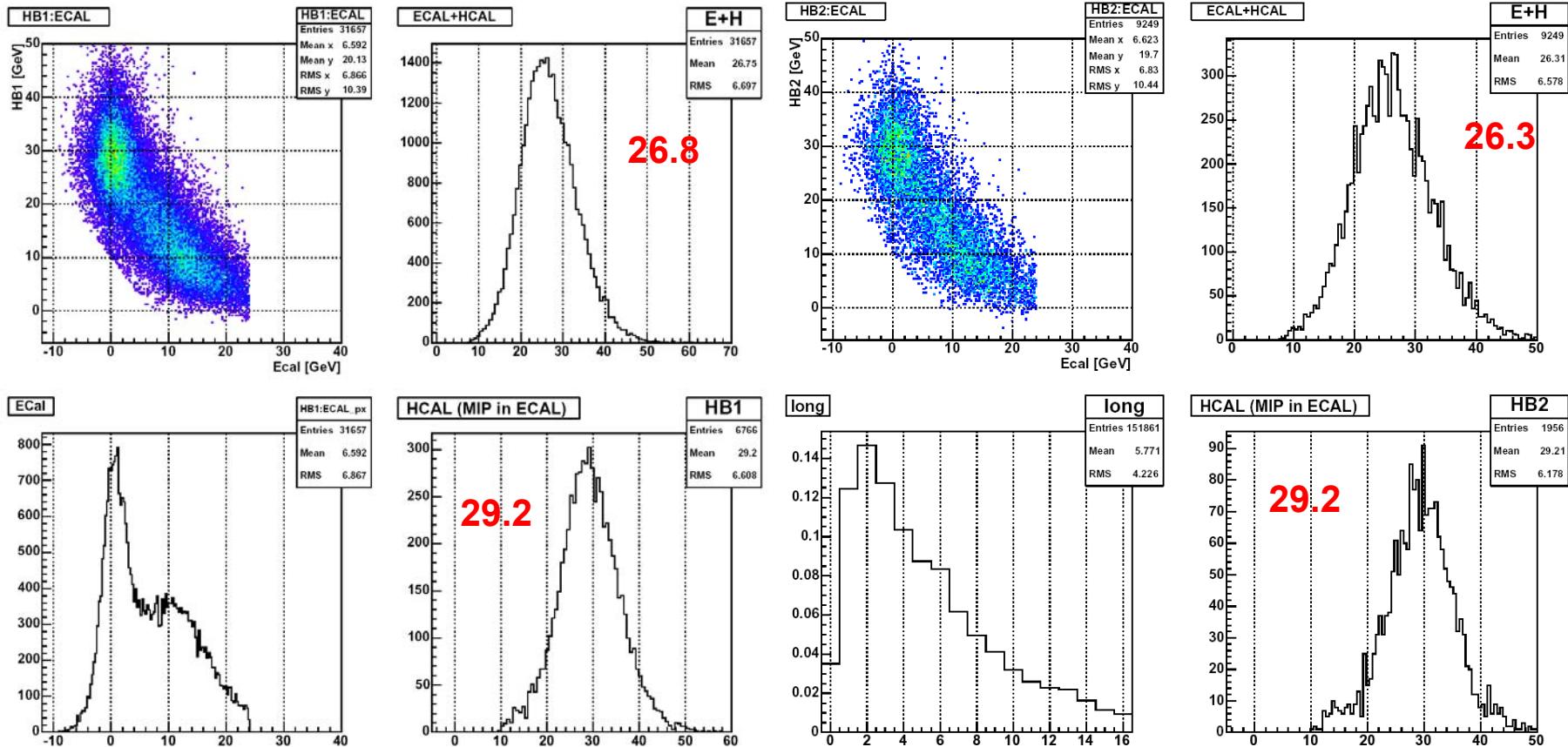


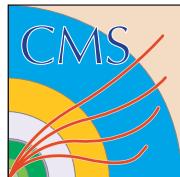
50GeV pi-



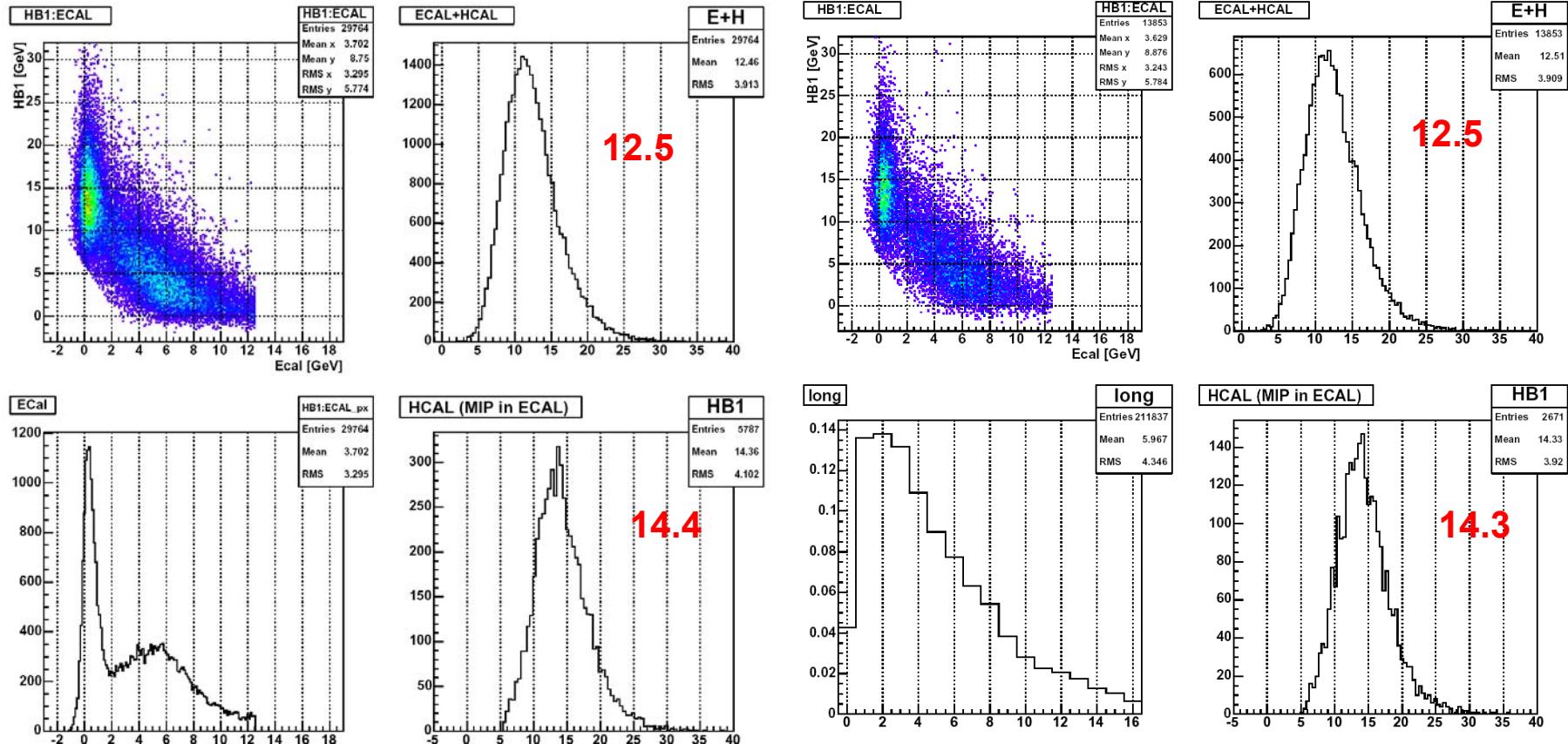


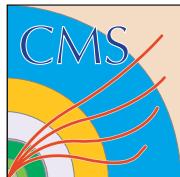
30GeV pi-



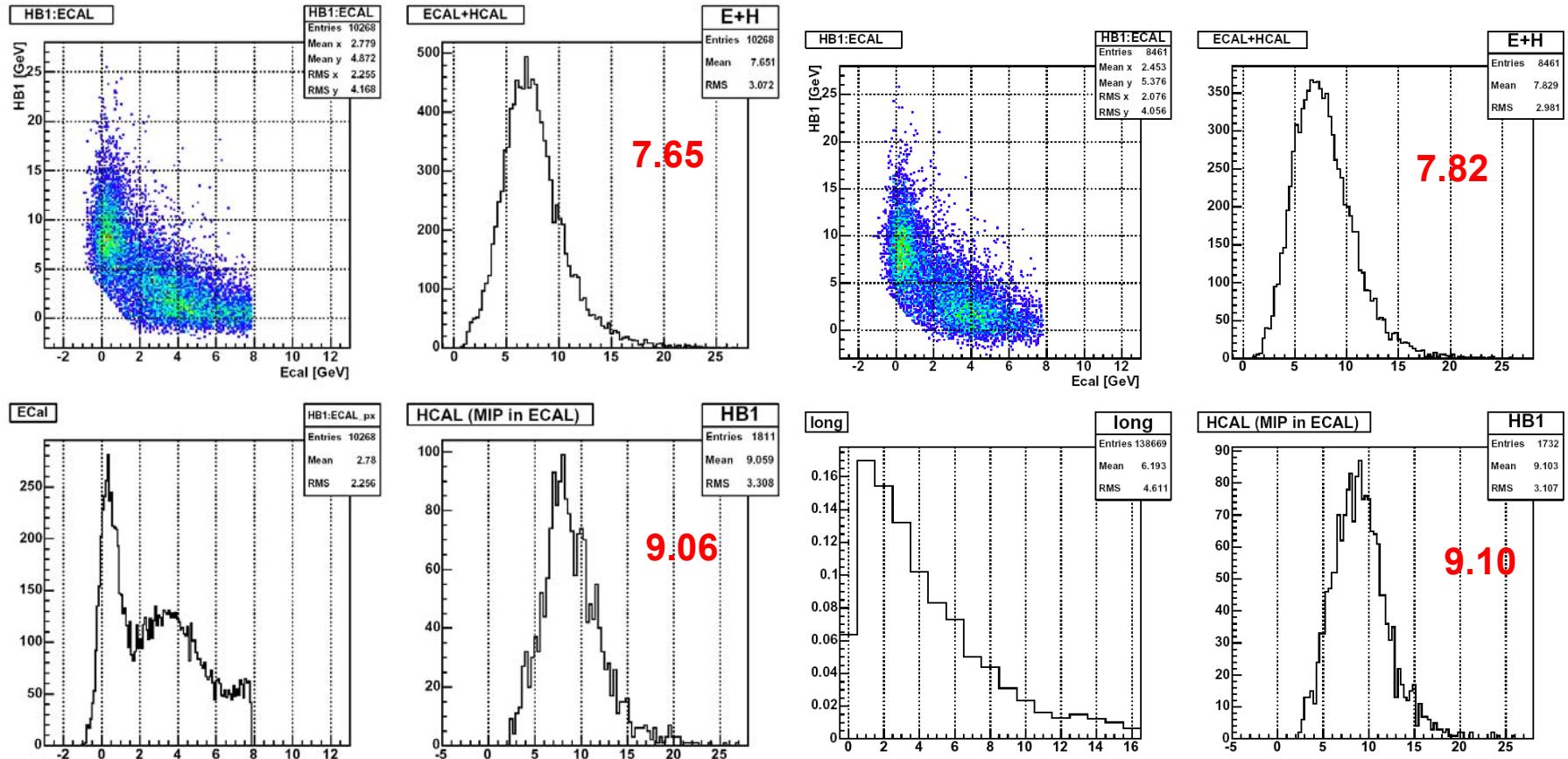


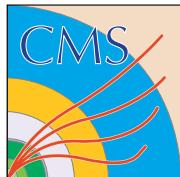
15GeV pi-



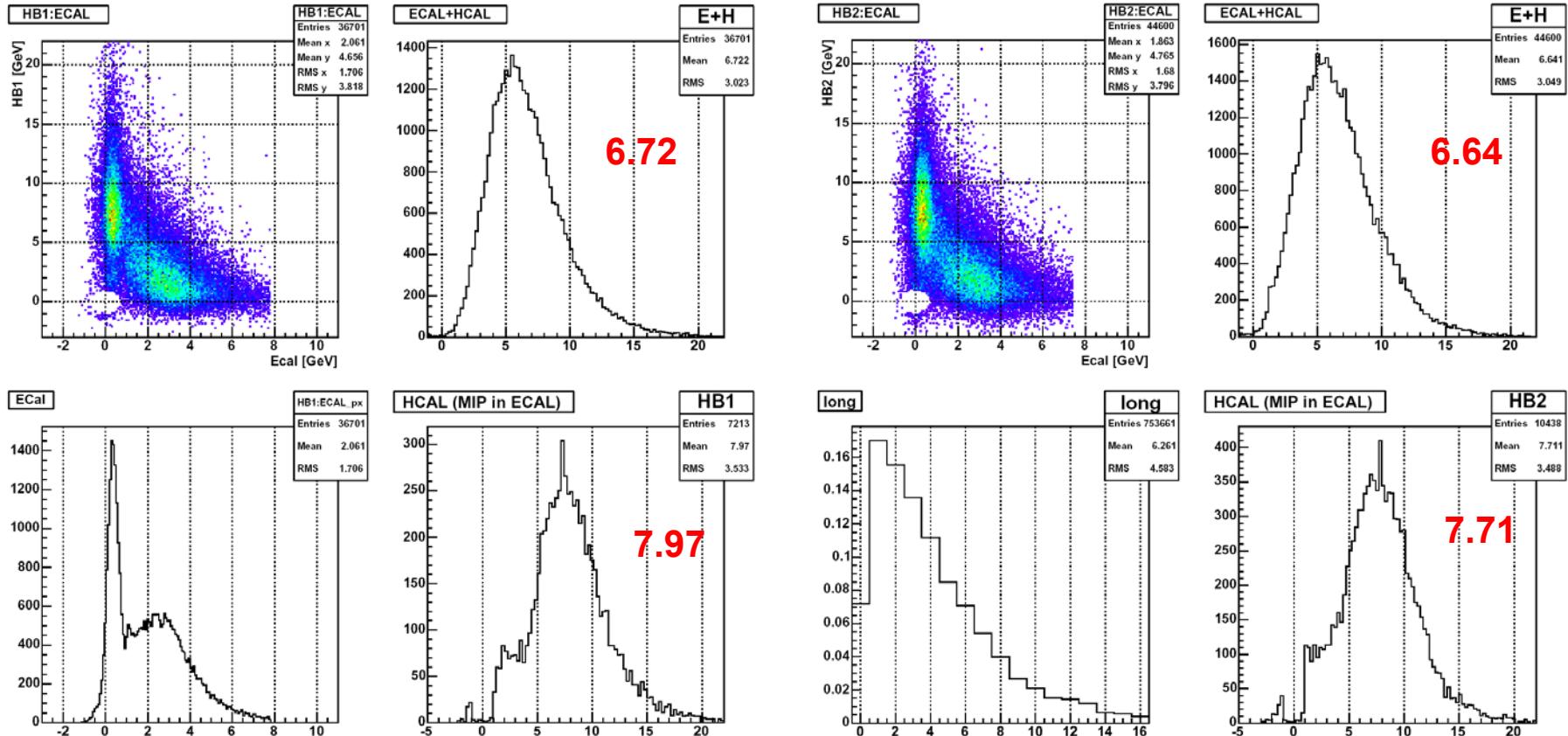


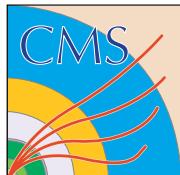
10GeV pi-



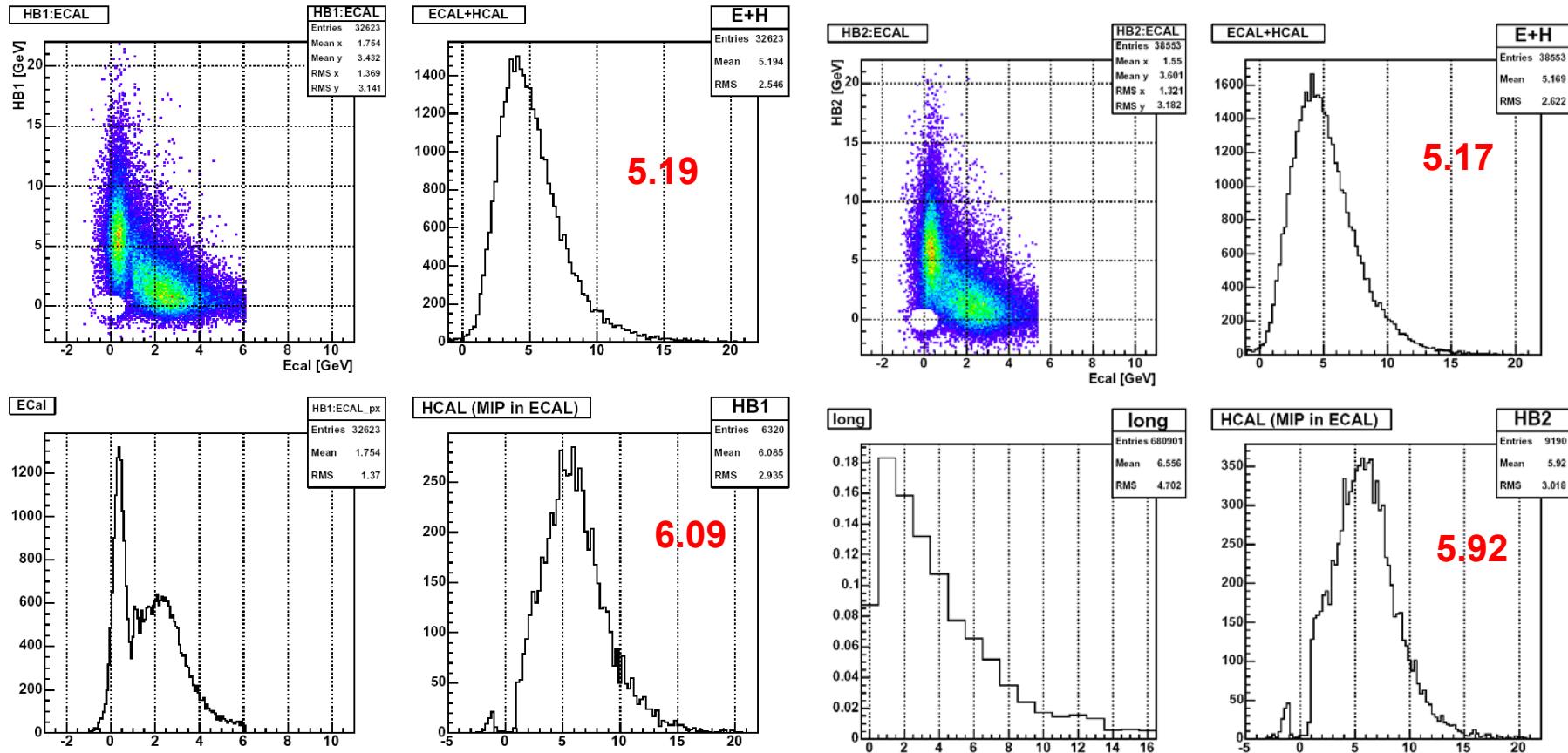


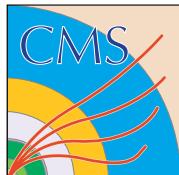
9GeV pi-



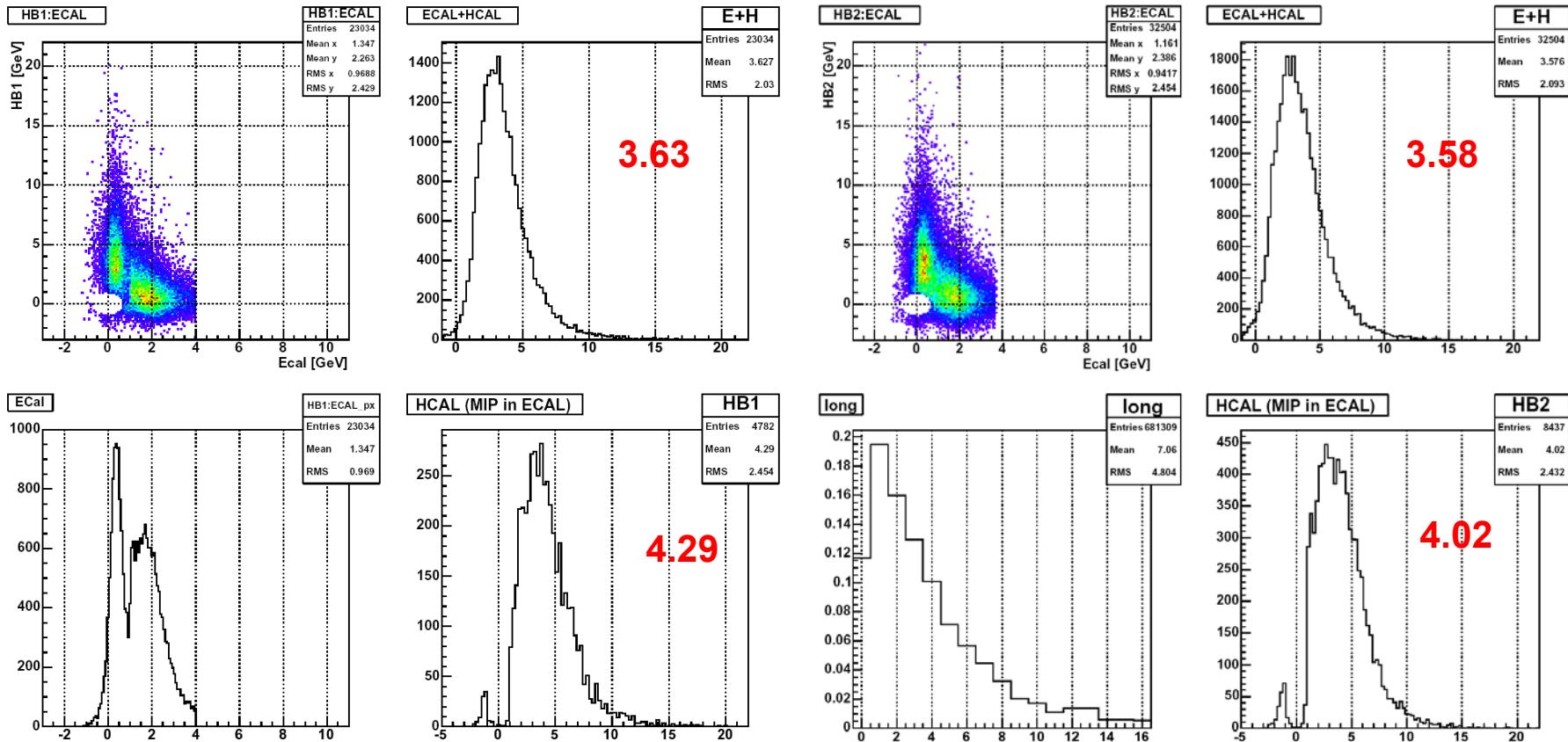


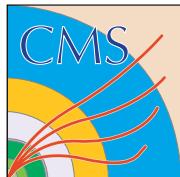
7GeV pi-



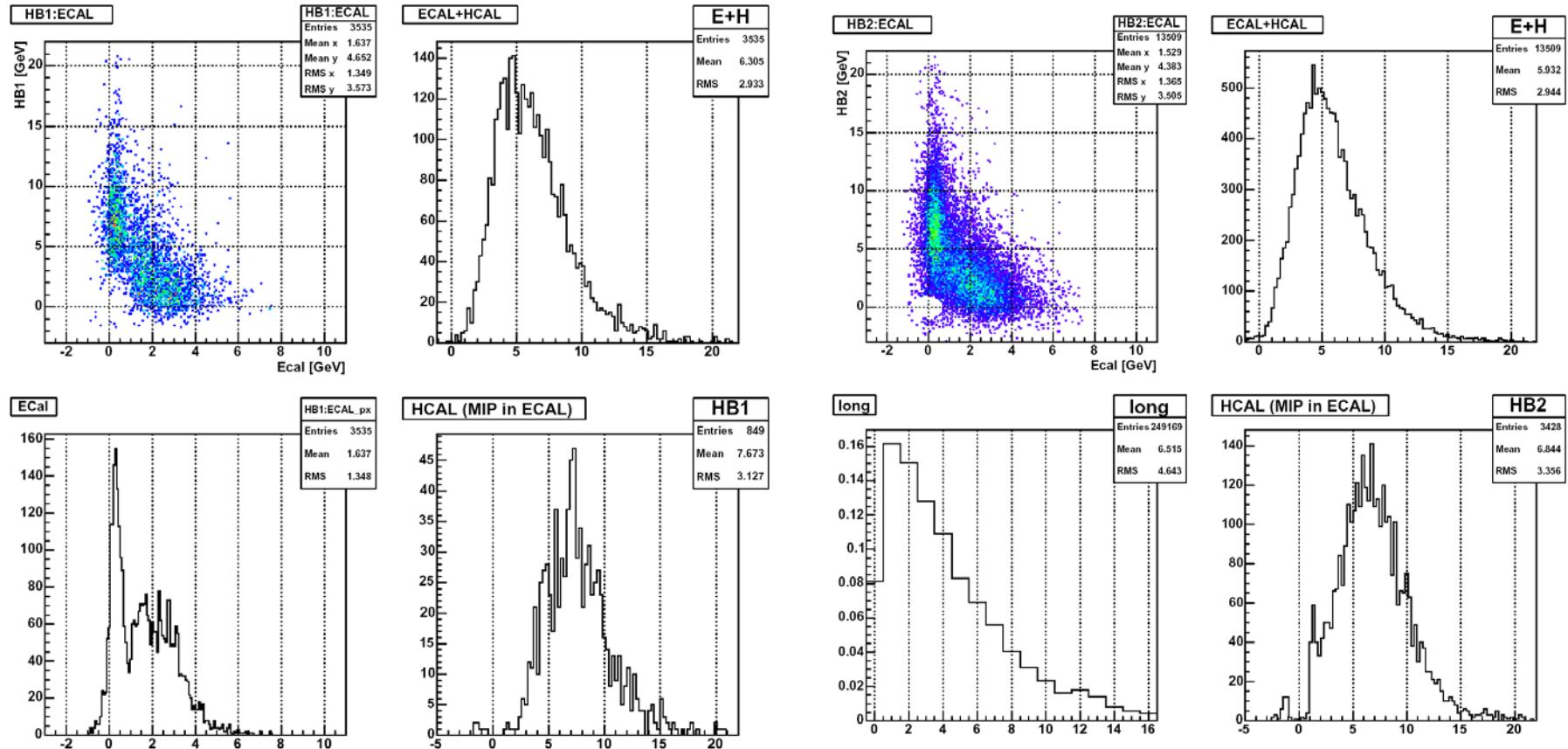


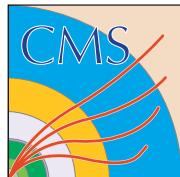
5GeV pi-



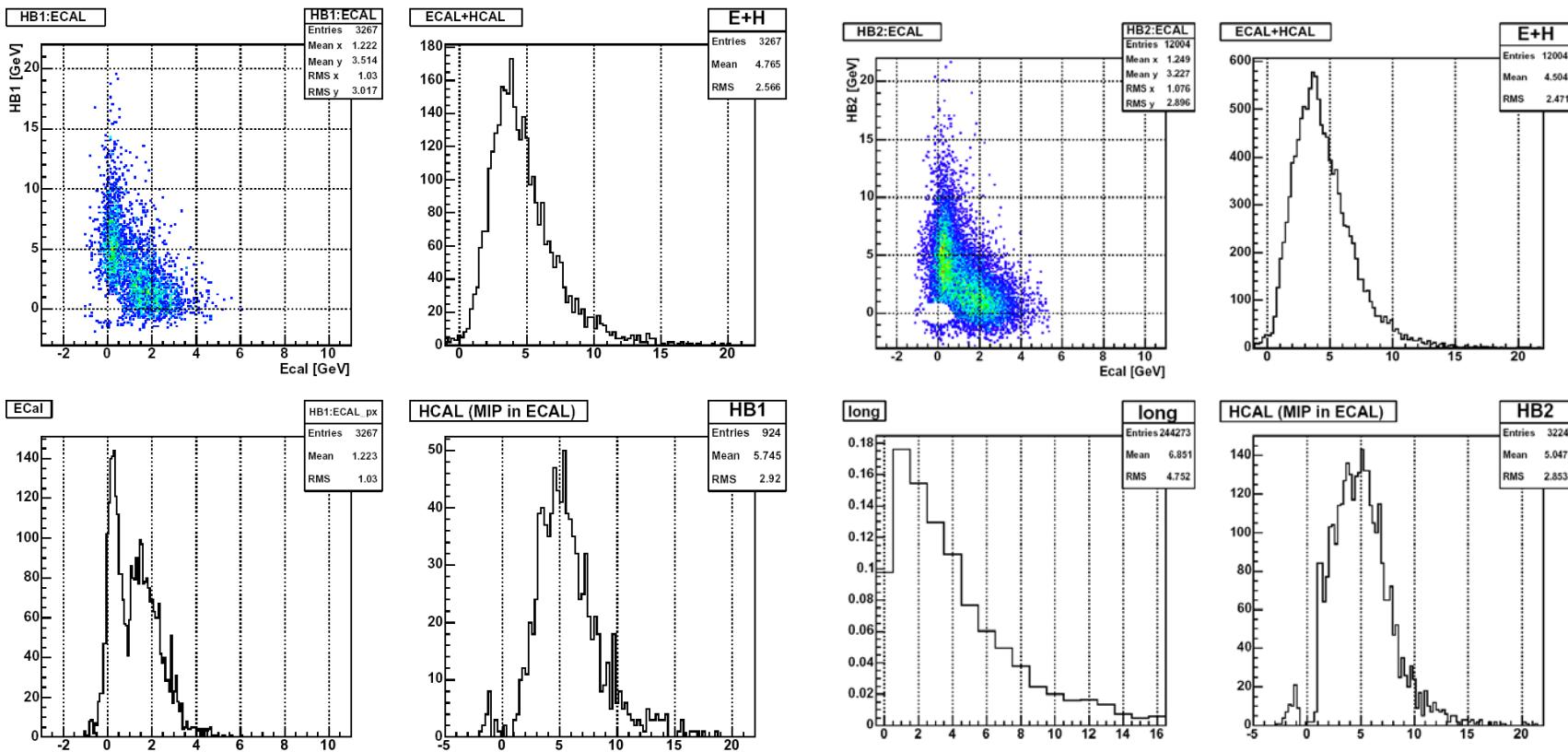


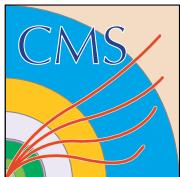
9GeV proton



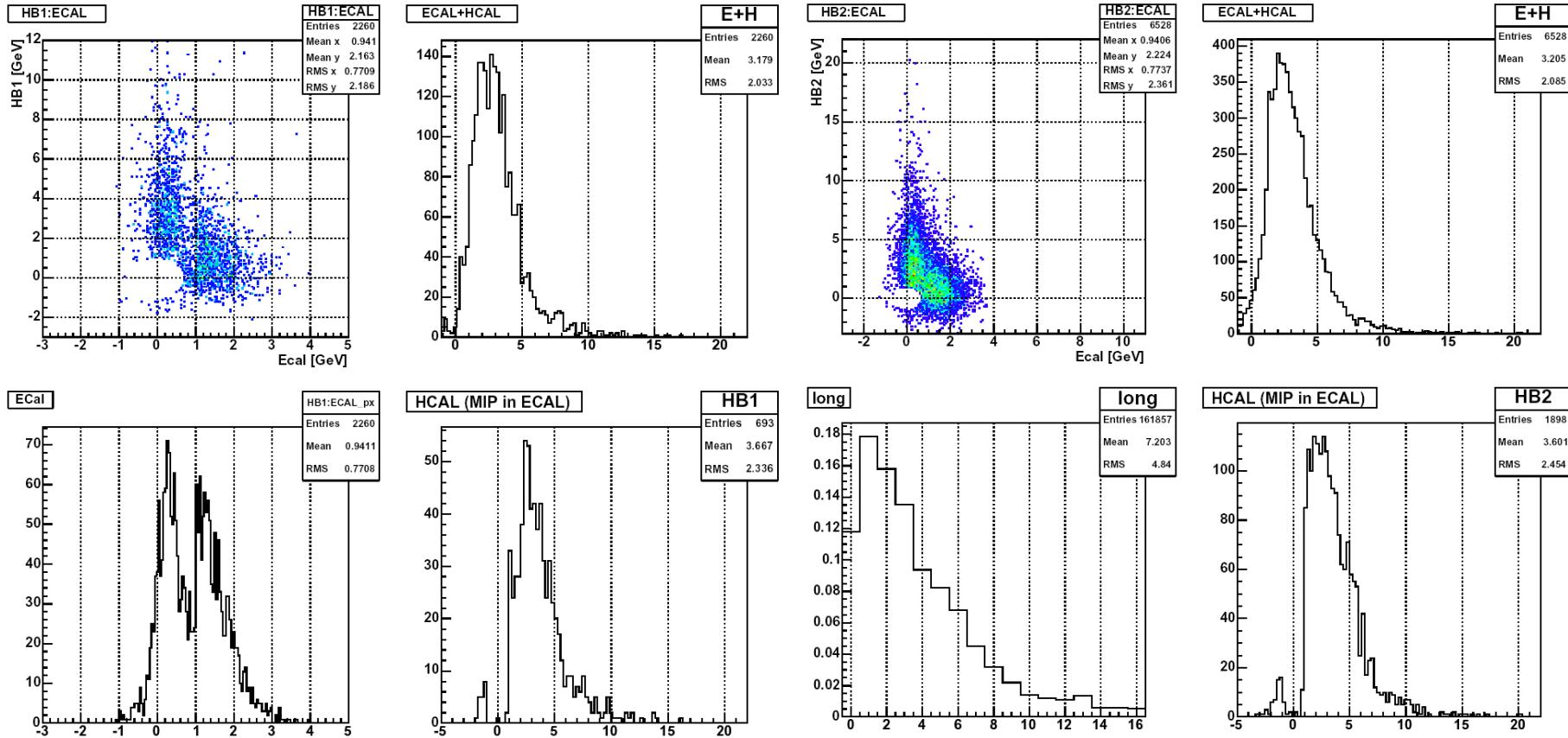


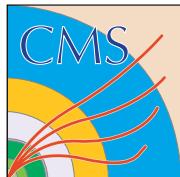
7GeV proton



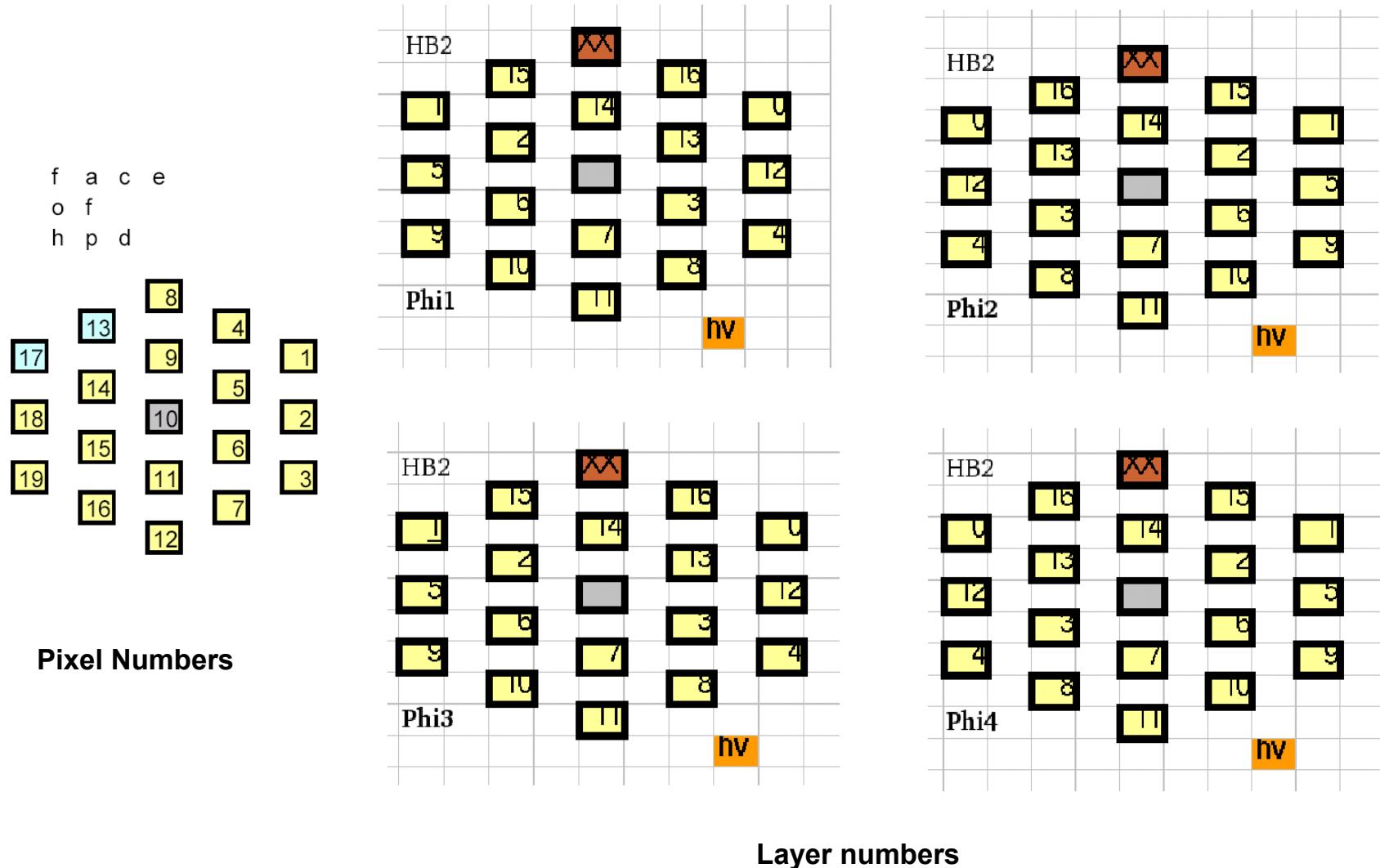


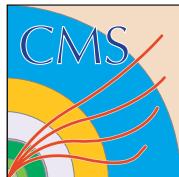
5GeV proton



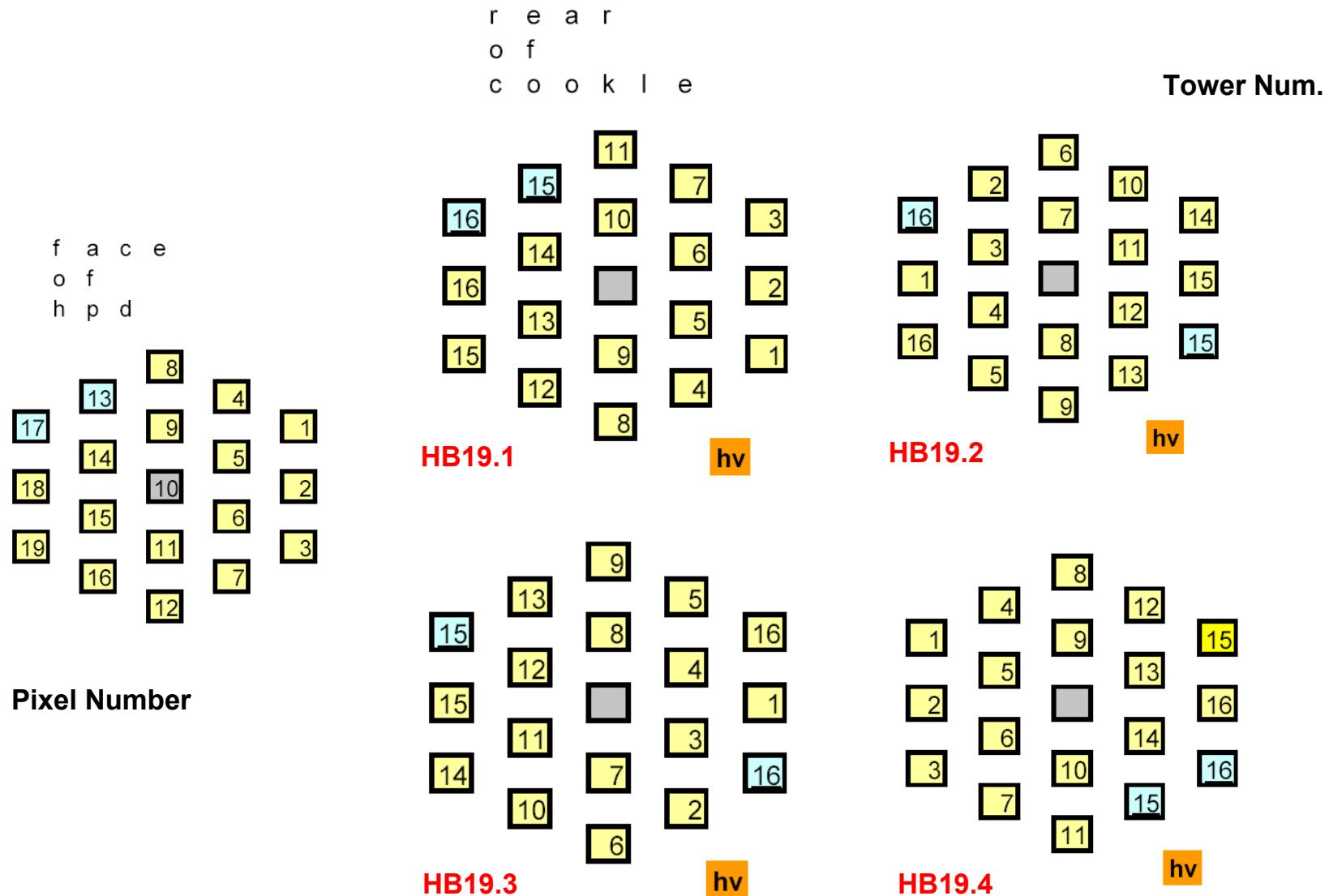


ODU (TB2004/HB2): layer-pixel map longitudinal readout

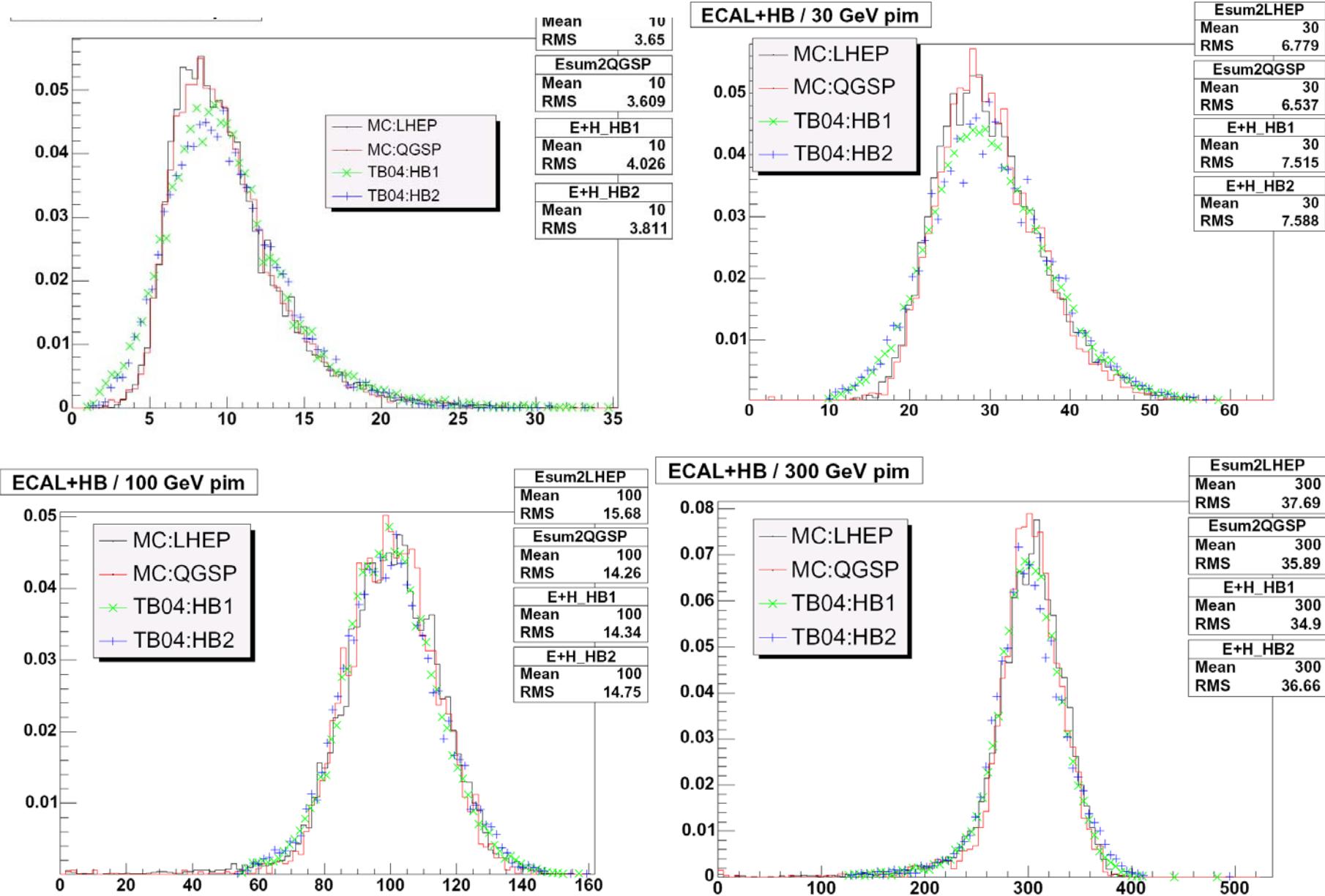




ODU (HB): tower-pixel map

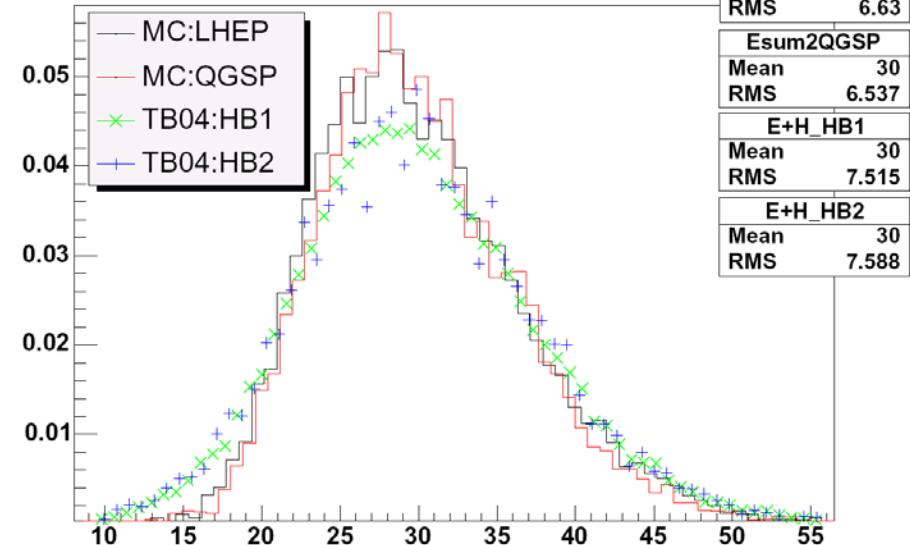
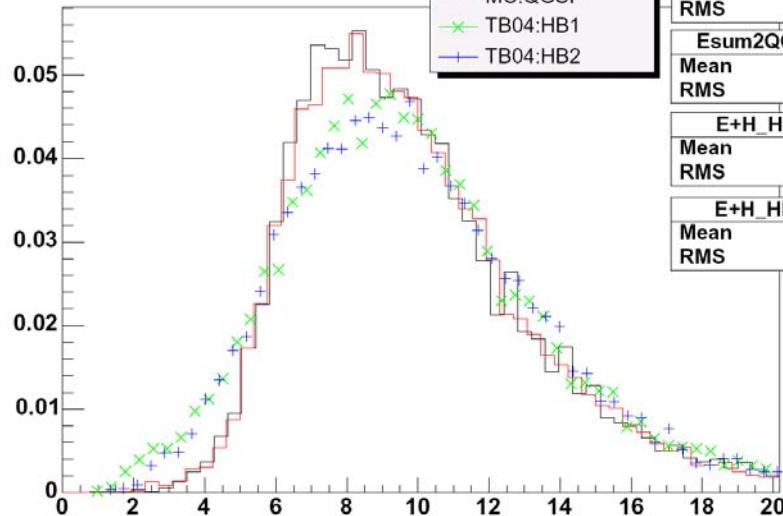


Comparison of Shapes (Area and mean normalized. MC: no digitization, no noise)

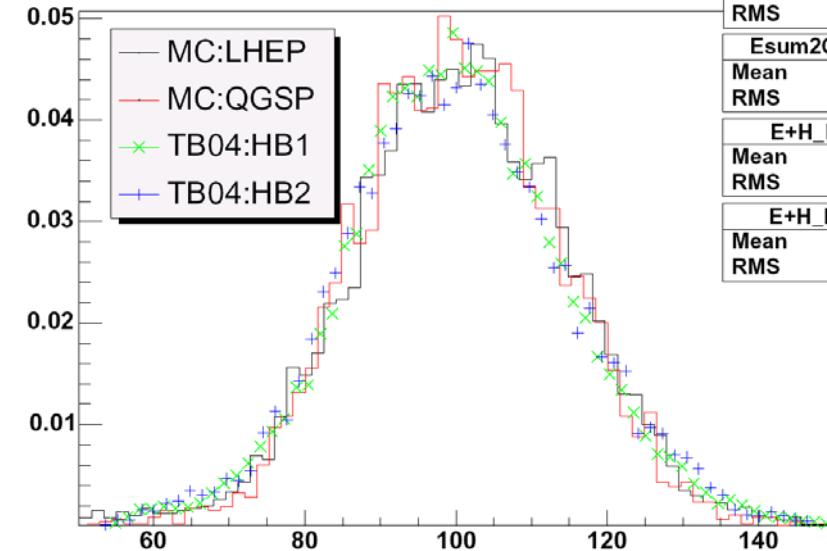


Comparison of Shapes (Area and mean normalized. MC: no digitization, no noise)

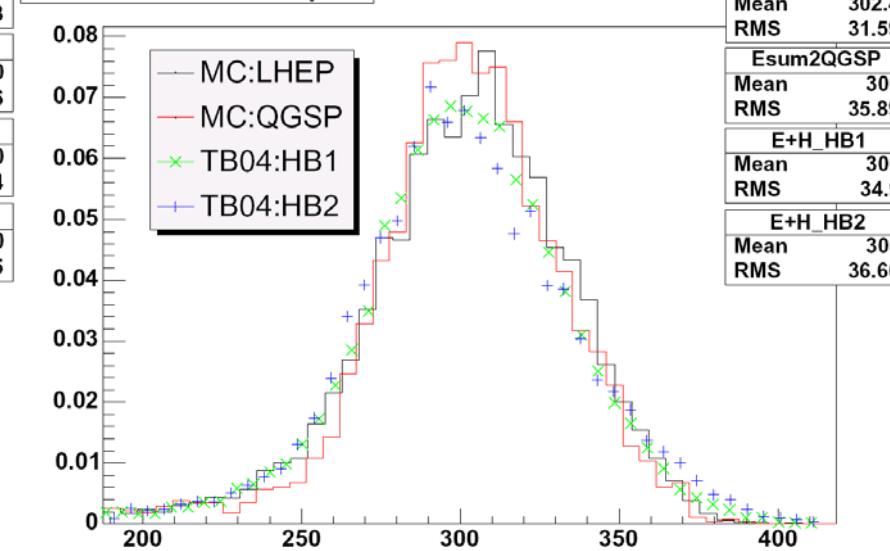
ECAL+HB / 10 Gev pim

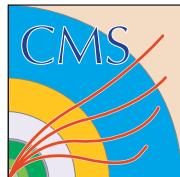


ECAL+HB / 100 GeV pim



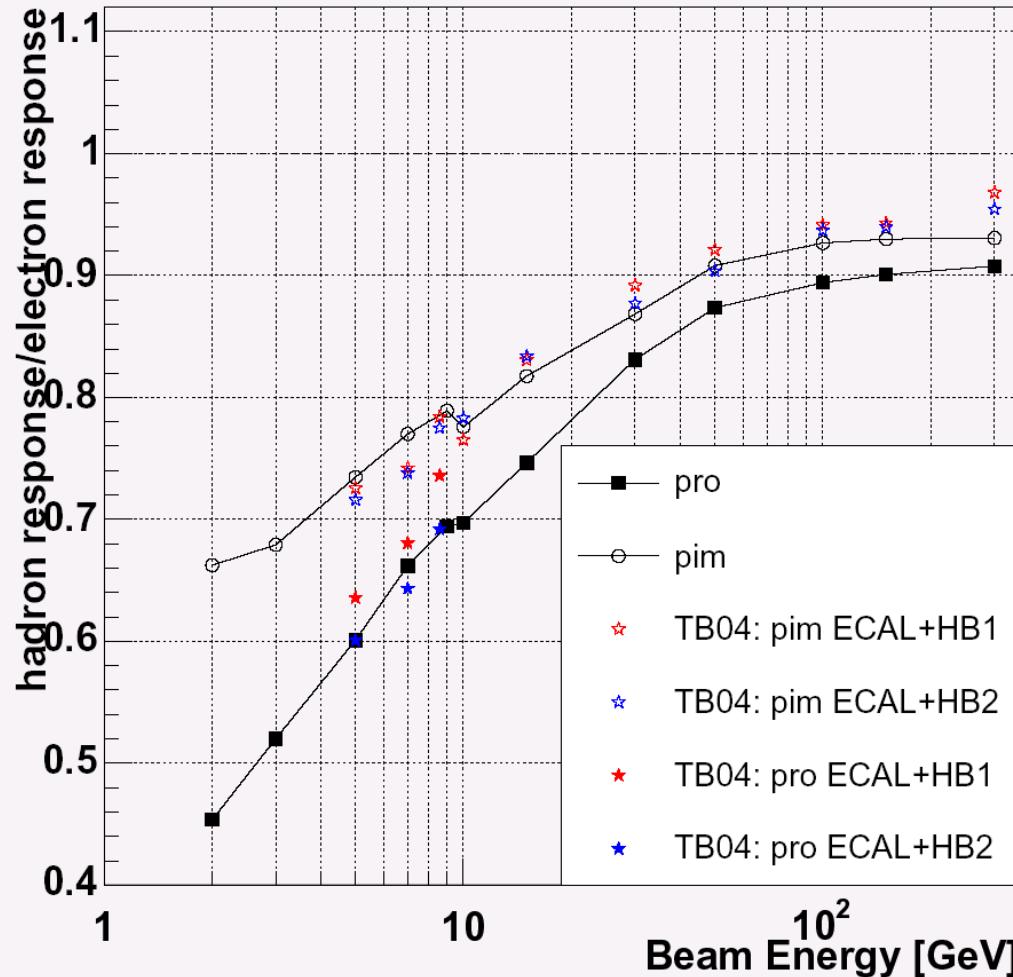
ECAL+HB / 300 GeV pim

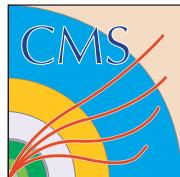




EC+HC

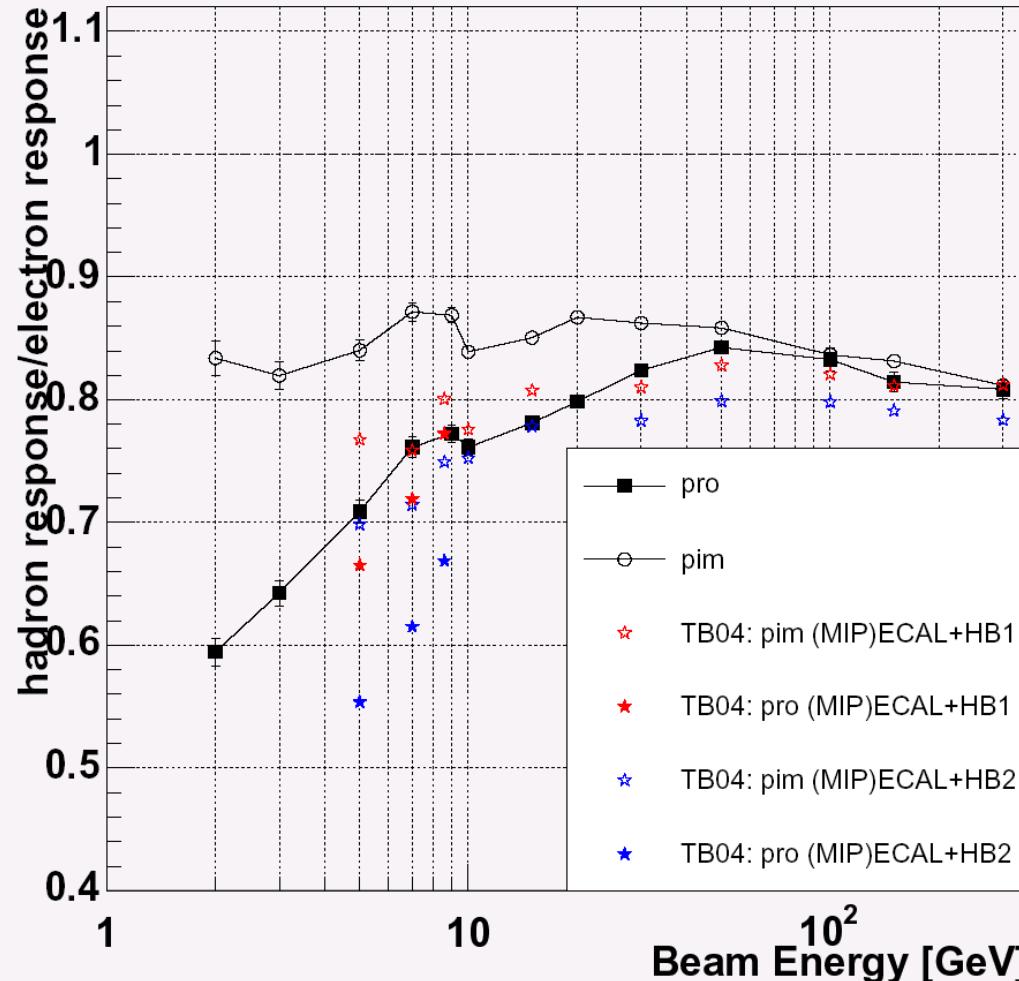
LHEP pi/e (No Birks corr.)

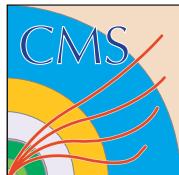




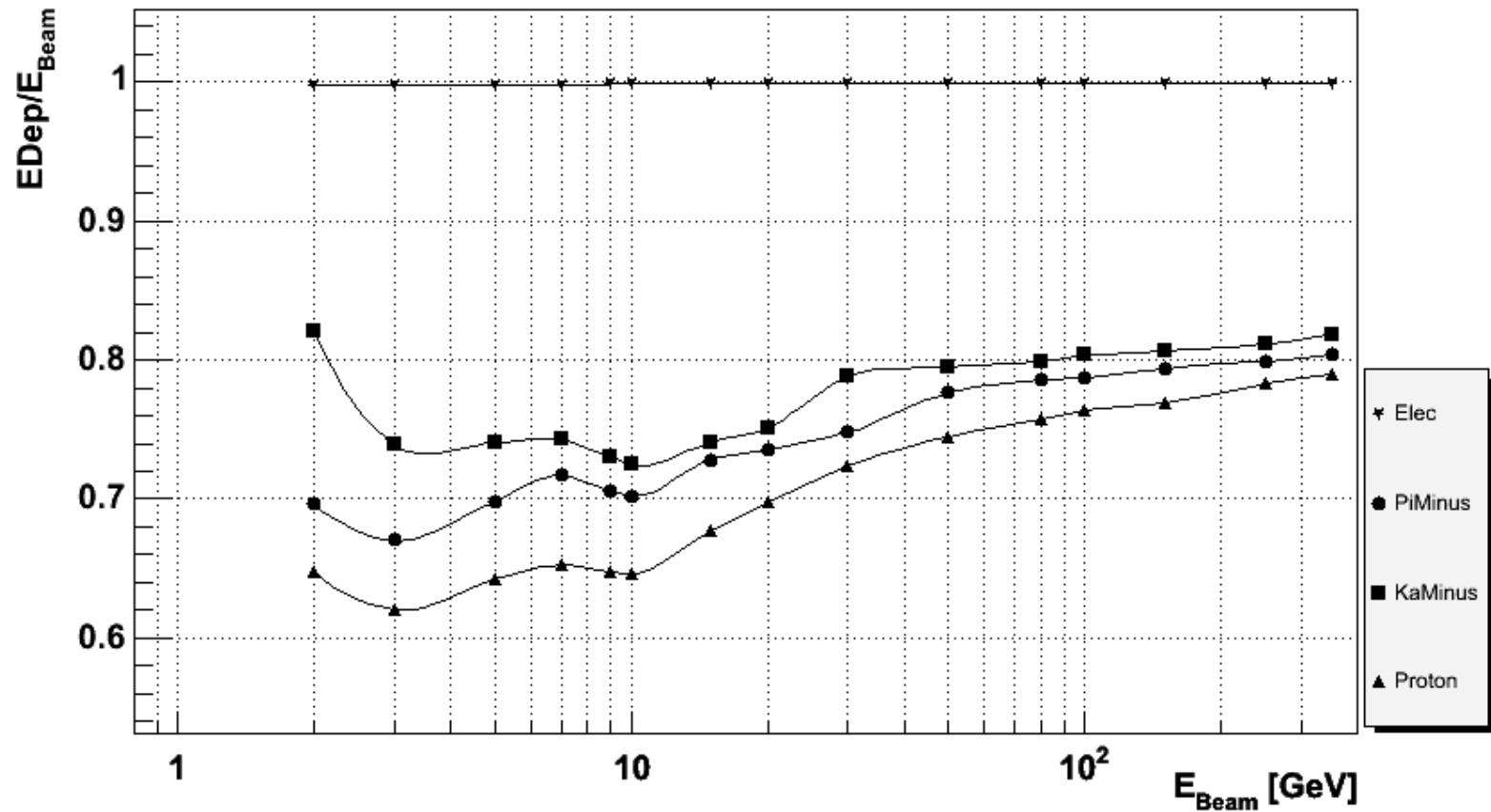
HB (mip in EC)

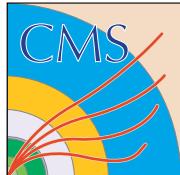
LHEP pi/e (No Birks corr.)



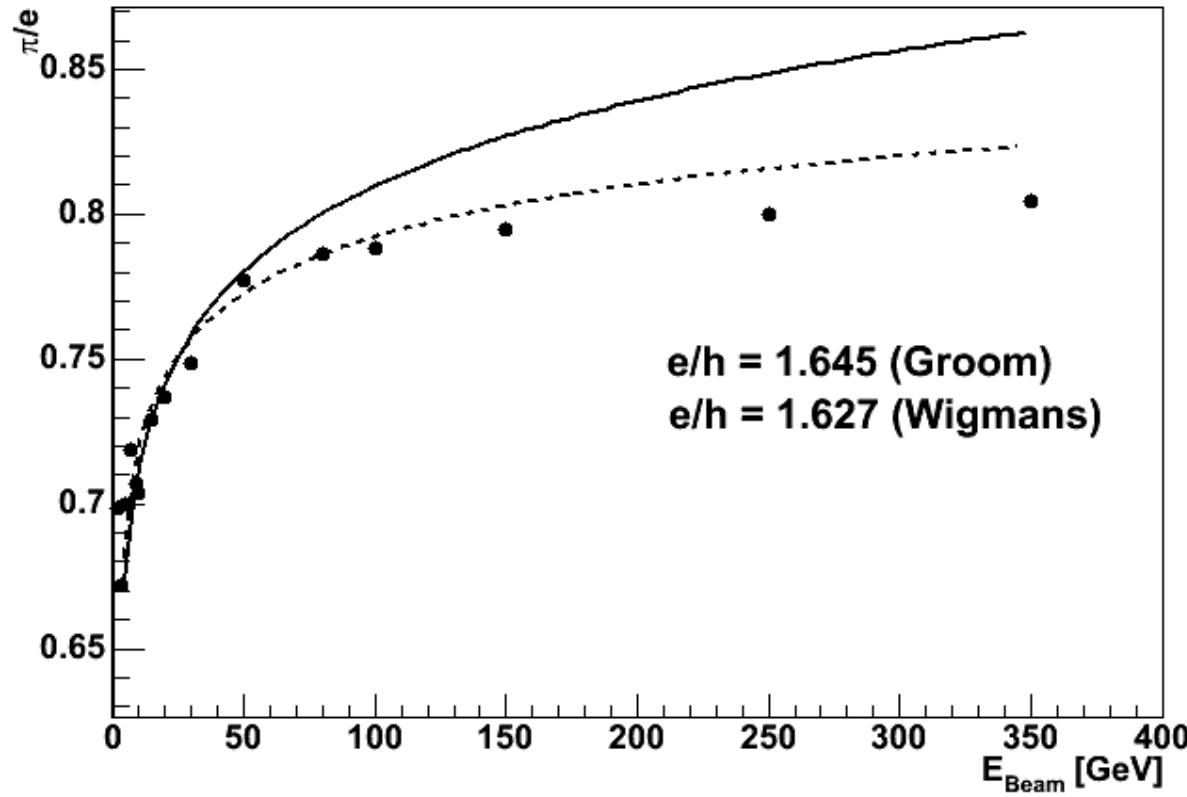


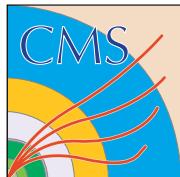
Big PbWO₄





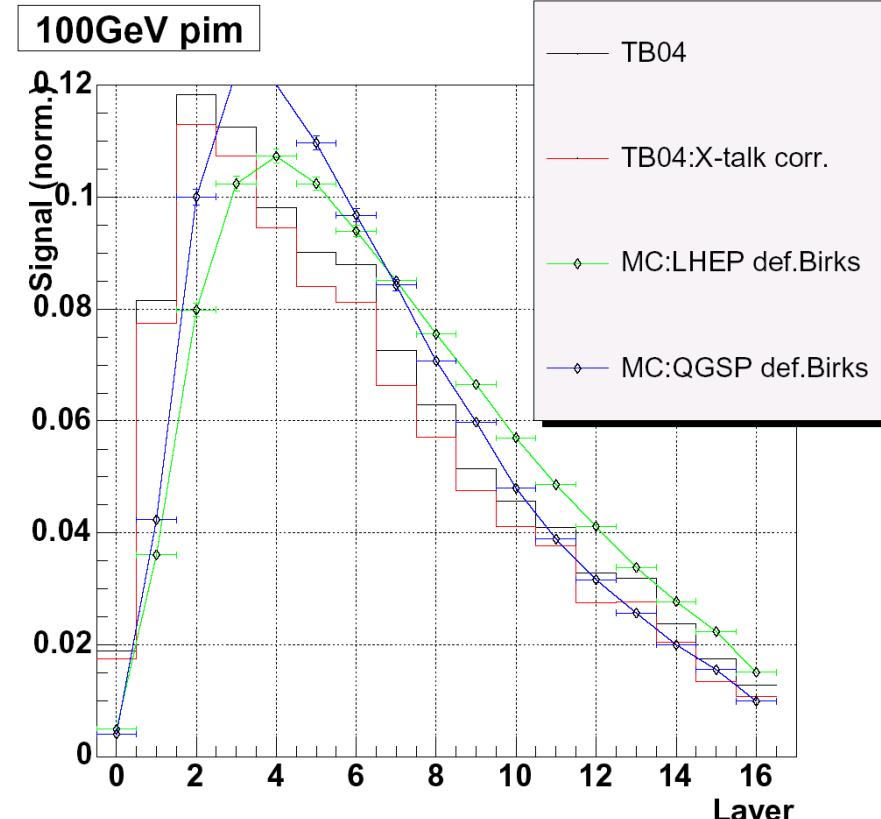
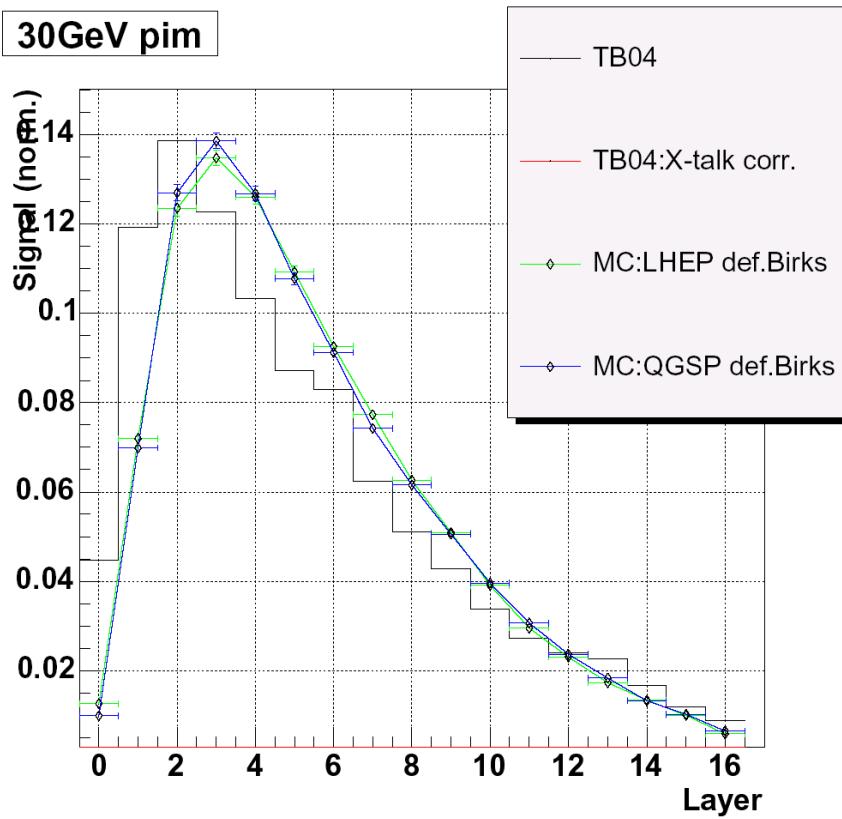
Big PbWO₄

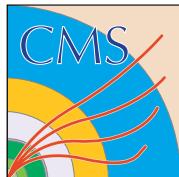




Longitudinal Shower Profile

MIP in ECAL.
MC- no aluminum block behind ECAL.

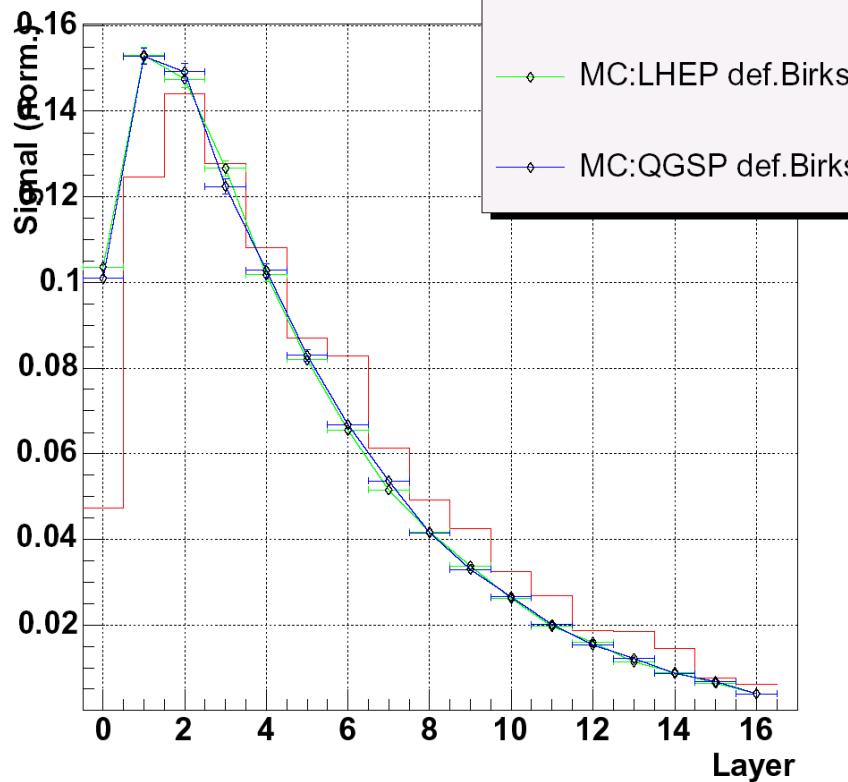




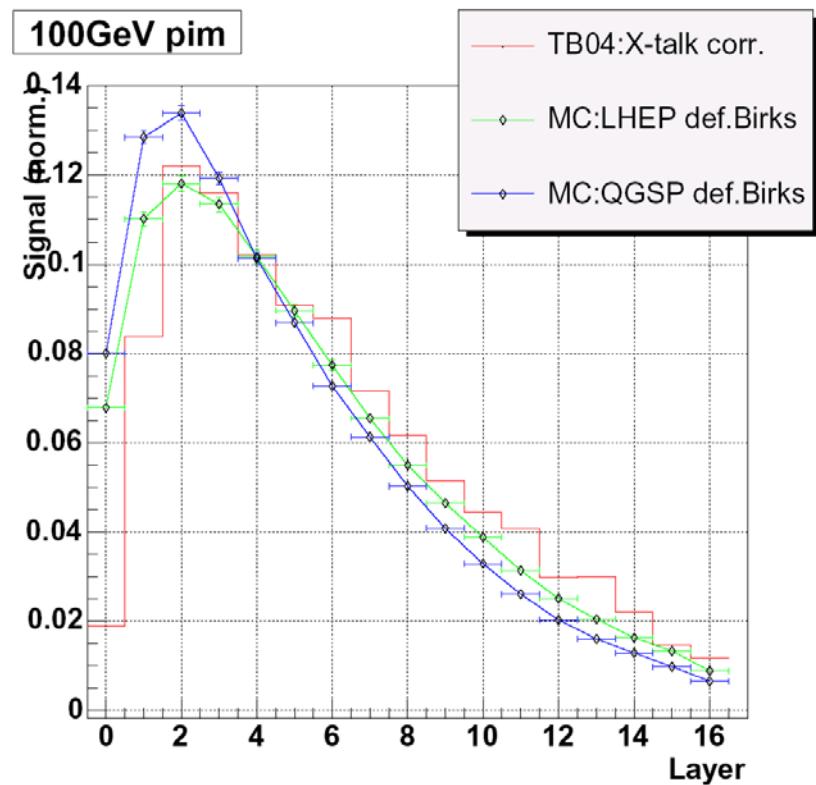
Longitudinal Shower Profile

MIP in ECAL.
MC- 8cm aluminum block behind ECAL.

30GeV pim



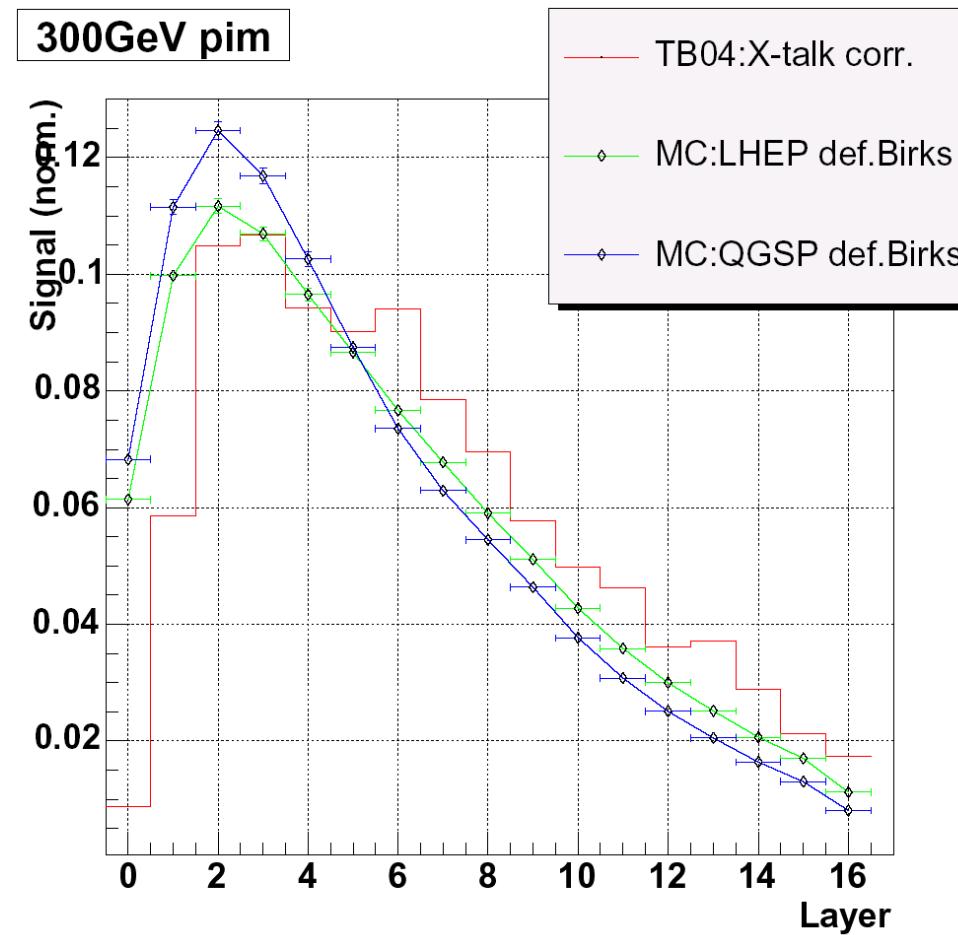
100GeV pim





Longitudinal Shower Profile

MIP in ECAL.
MC- 8cm aluminum block behind ECAL.





Additional Slides

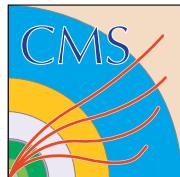


Conclusion

We have achieved all TB2004 goal.

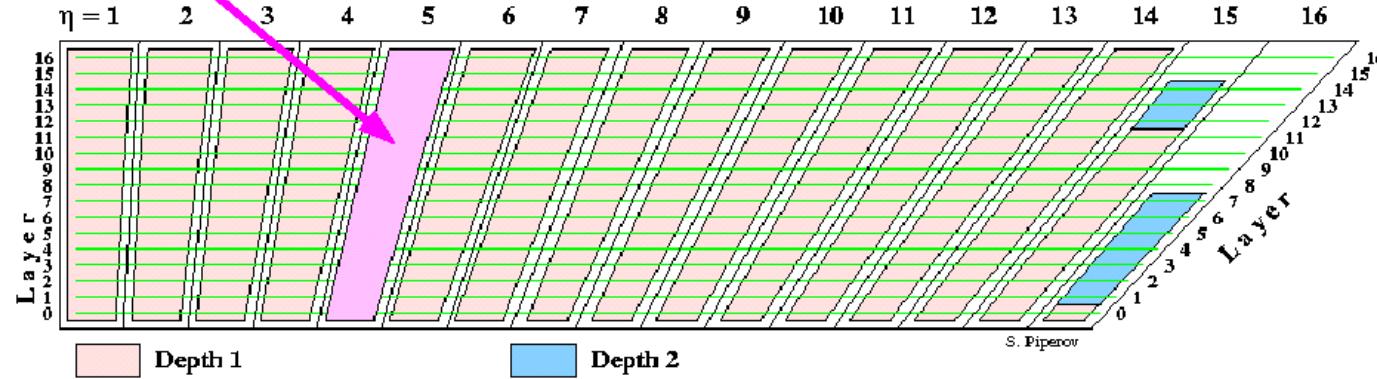
- Data set (3-300GeV) for G4 validation.
- L1 trigger primitive generation.
- Slice test with ME.
- Operation and verification of all calibration system.
- Remote monitoring and data analysis.
- Complete data flow from detector through ORCA, (including access to ConditionsDB.)

→G4 validation is in progress.
→A lot of data to analyze.

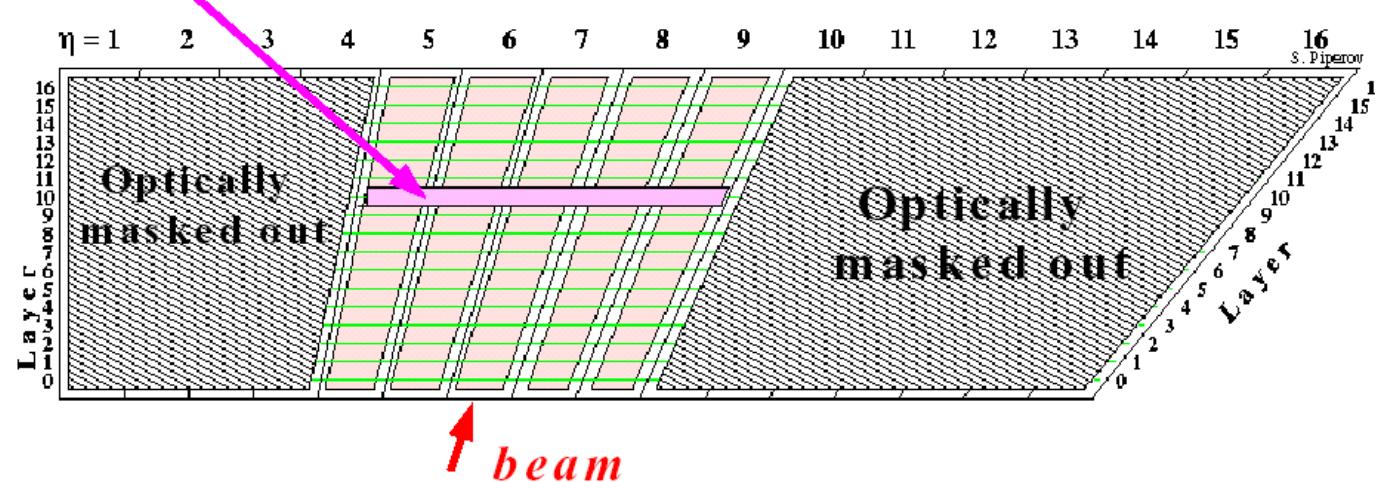


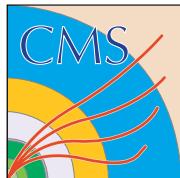
HB Configuration

HB1: tower like – layers a summed optically



HB2: layer like – *longitudinal shower profile*





GEANT4 Validation

Test of physics models for hadron showers

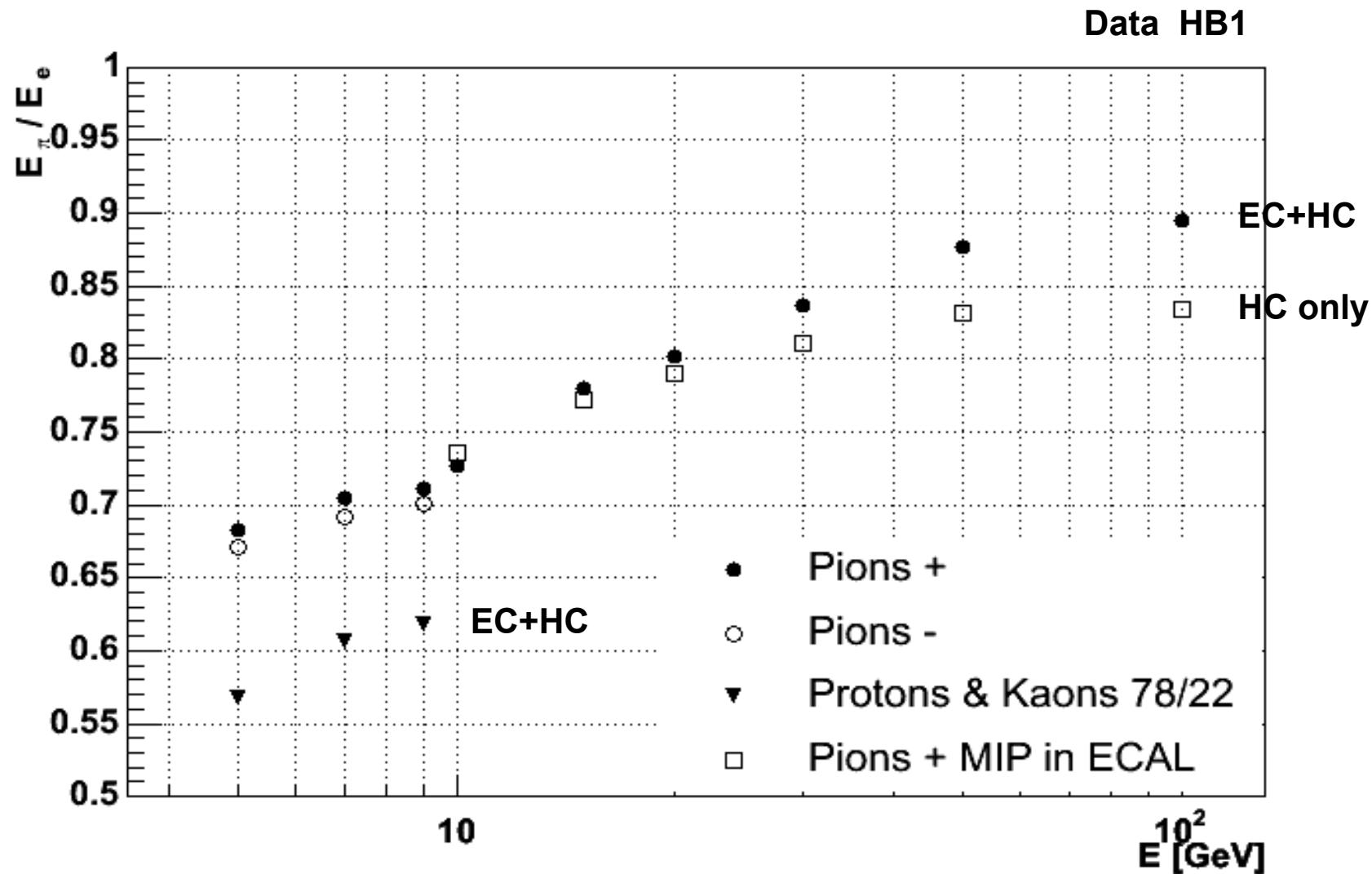
- Response
 - Resolution - shape of dN/dE (no gaussian shape)
 - Linearity - pion/electron and proton/electron
- Shower profile
 - Longitudinal
 - Transverse

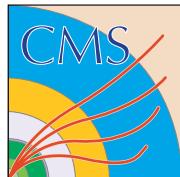
Calorimeter setup

- HF
 - Cerenkov → sensitive to π^0 in shower.
- EC+HB+HO
 - Scintillation → scintillation saturation effect (Birks' law)?



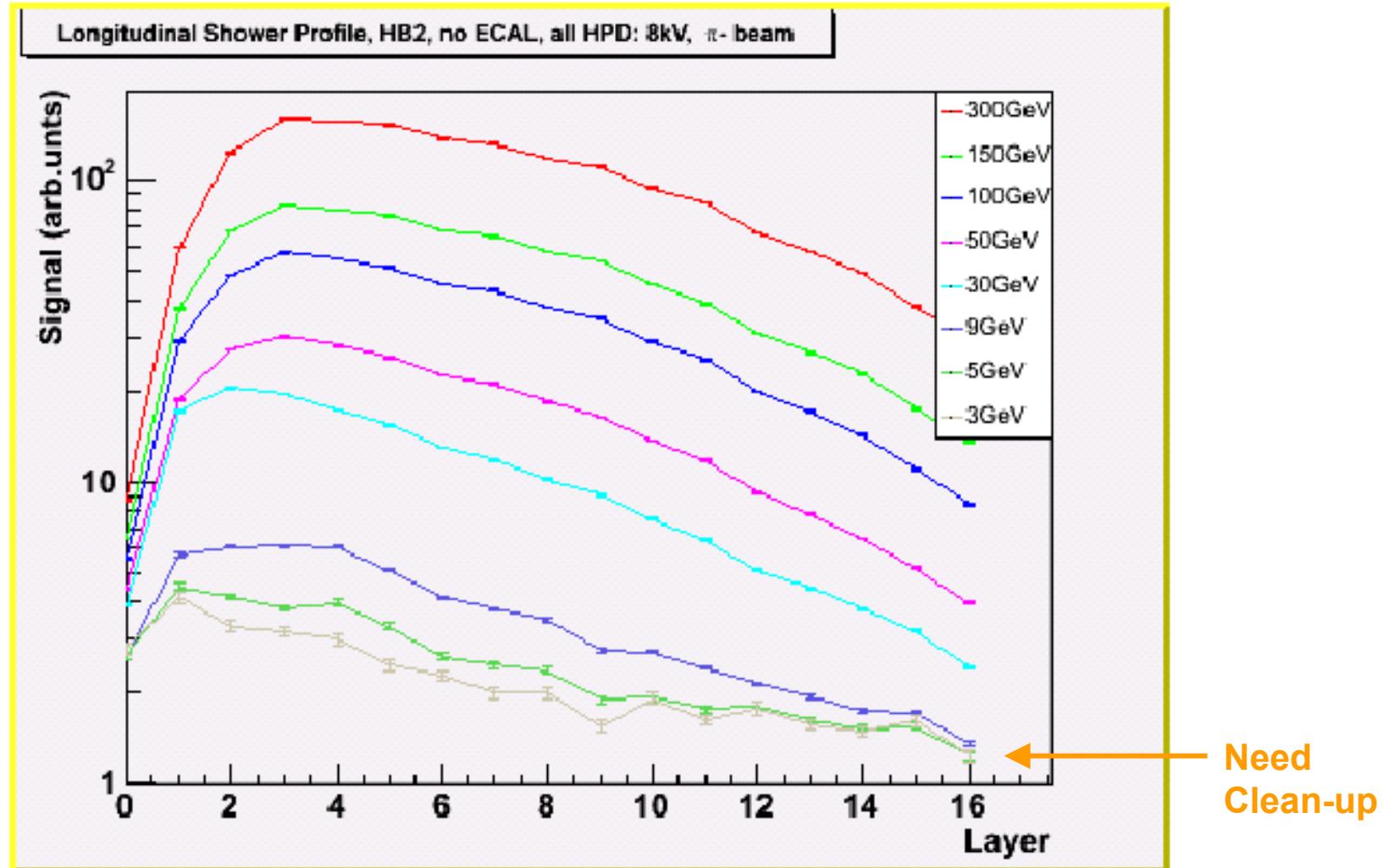
Data: π/e (very preliminary)

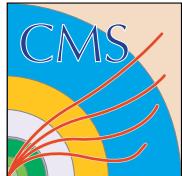




First look of Longitudinal Shower Profile

HB2 only





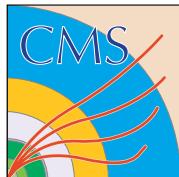
TB2006 Plan

Goal:

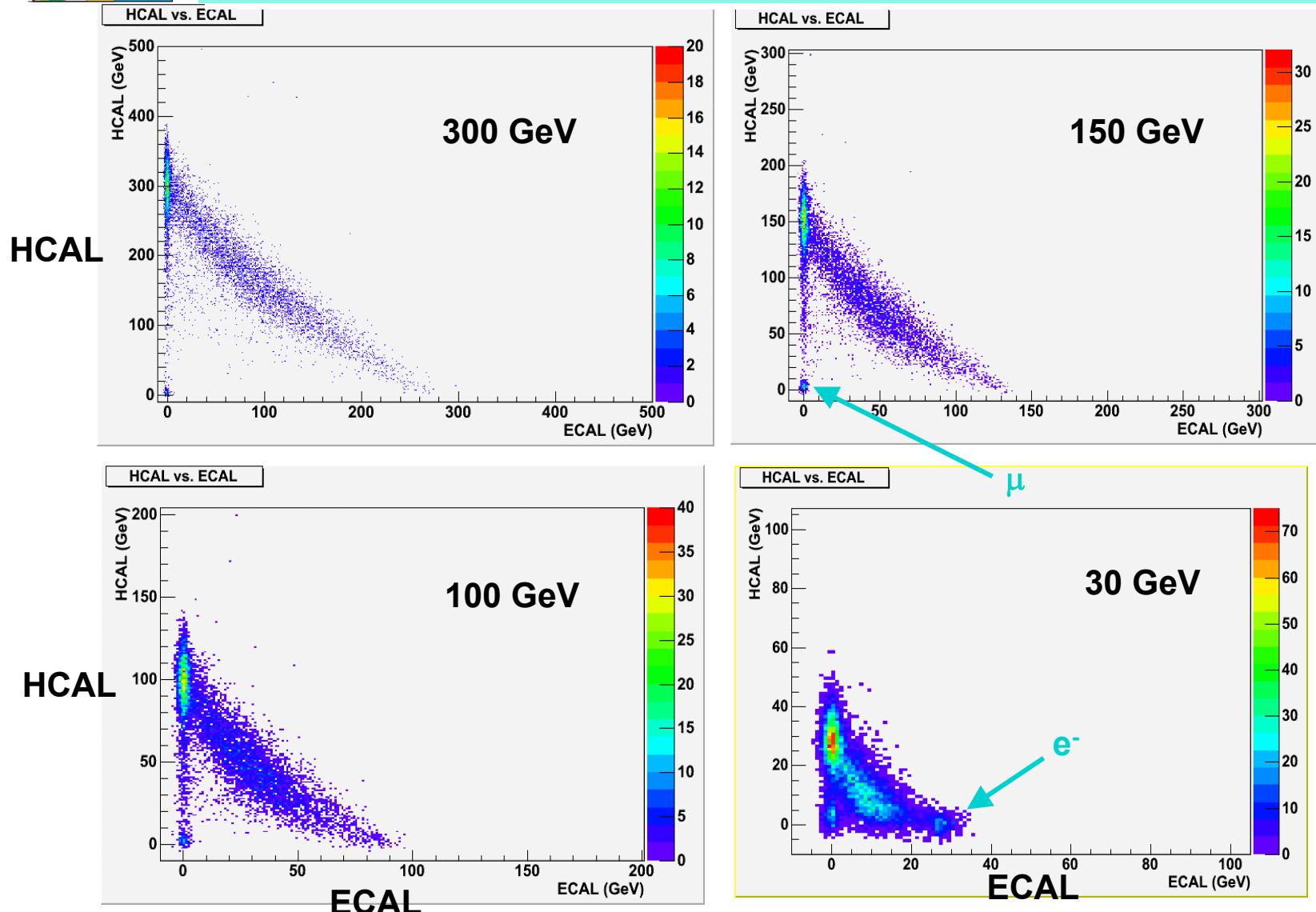
- Perform full system test with “production” HW and SW.
 - Generation of TPG and Raw Data.
 - Operation of calibration system.
- Measure performance of EC+HC combined system.
 - Improve pi/e measurement for 2-300GeV.
 - Measure material distribution between ECAL and HCAL.
 - Look for any surprise, e.g. nuclear counter effects in APD, etc.

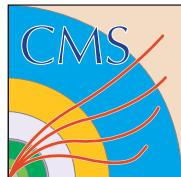
Needs:

- ECAL super module.
- Improved testbeam triggering/tagging system.
 - tags – muons, beam interactions, P-ID.



pi- : High Energy Data



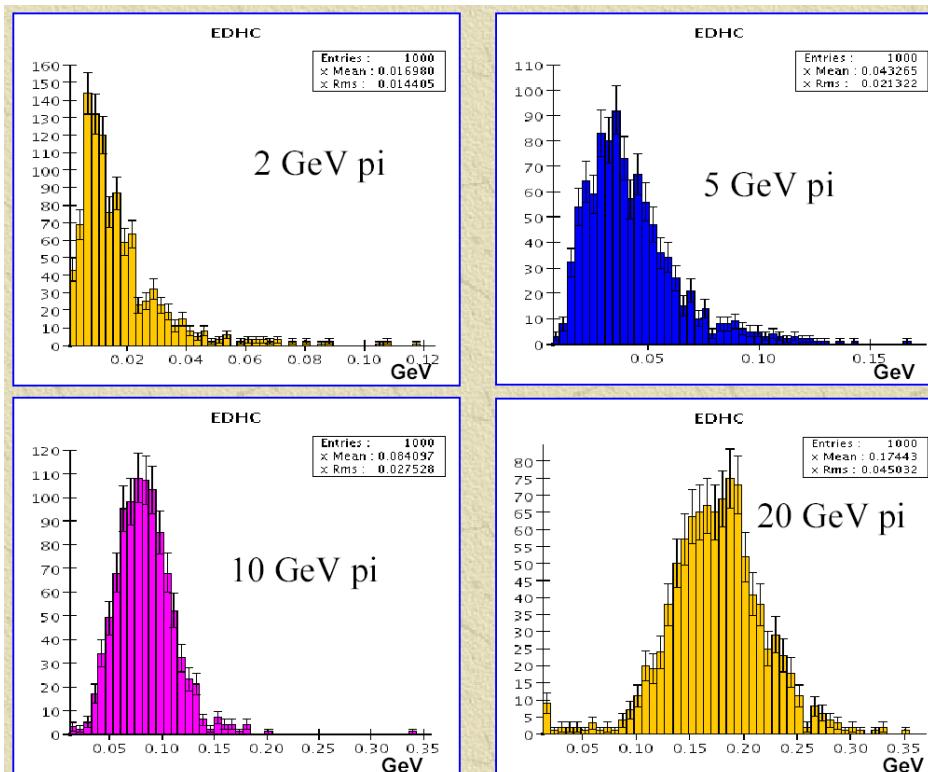


Low Energy Data

It is very important to understand the calorimeter response to low energy particles for simulation and reconstruction of jets and MET.
Low energy data (below 30GeV) were missing in TB2002-2003.

G4 Simulation

HCAL alone

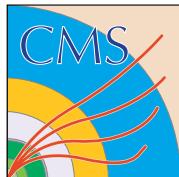


Test beam Needed:

- Particle ID with Cerenkov counter.
- Muon halo veto.
- Different G4 Simulations in advance - determine which parameters need to be tested.

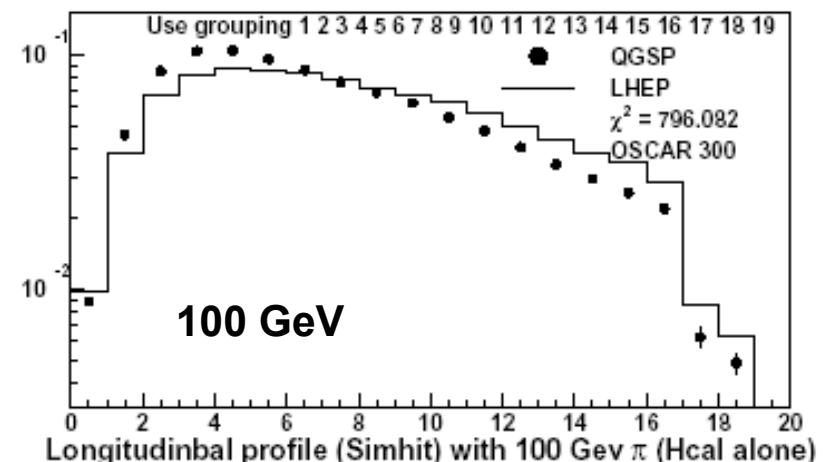
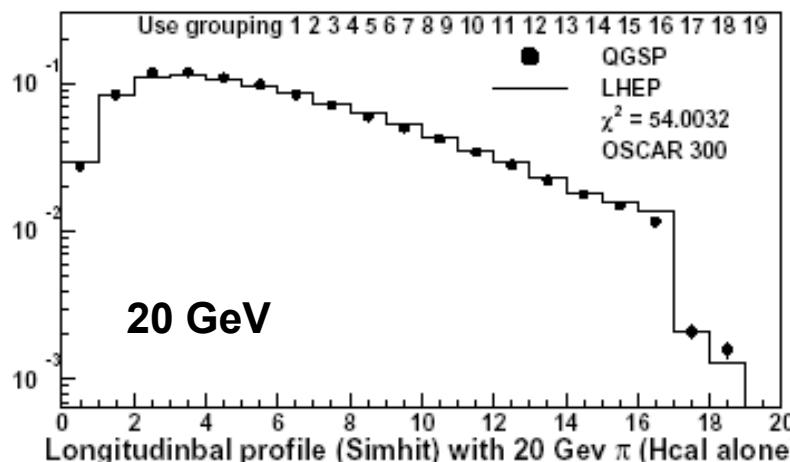
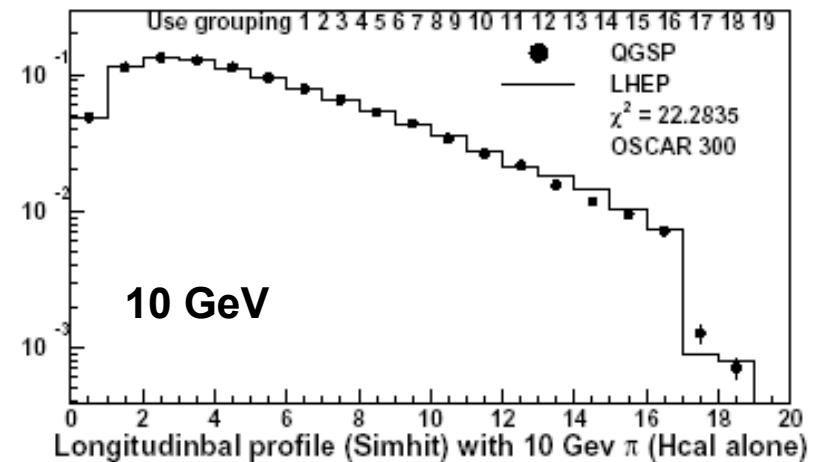
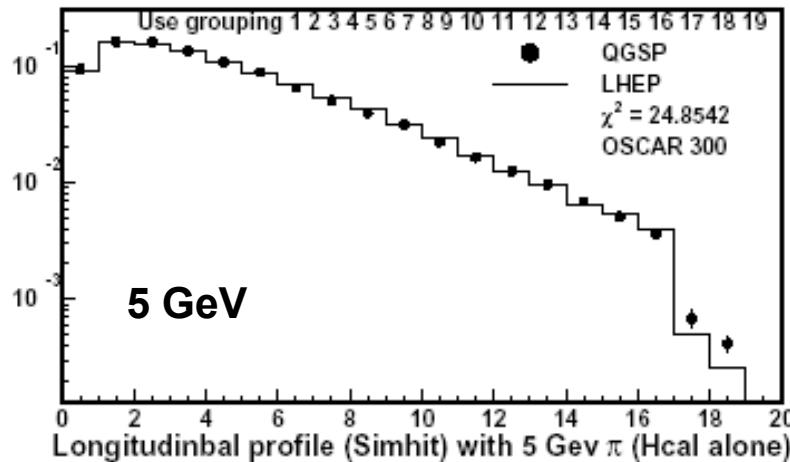
Data sets in TB2004.

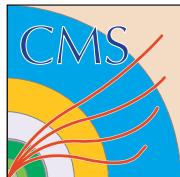
- Low: 2, 3, 5, 7, 9 GeV
- Intermediate: 10, 15, 20, 30
- High: 30, 50, 100, 150, 300



G4 Validation

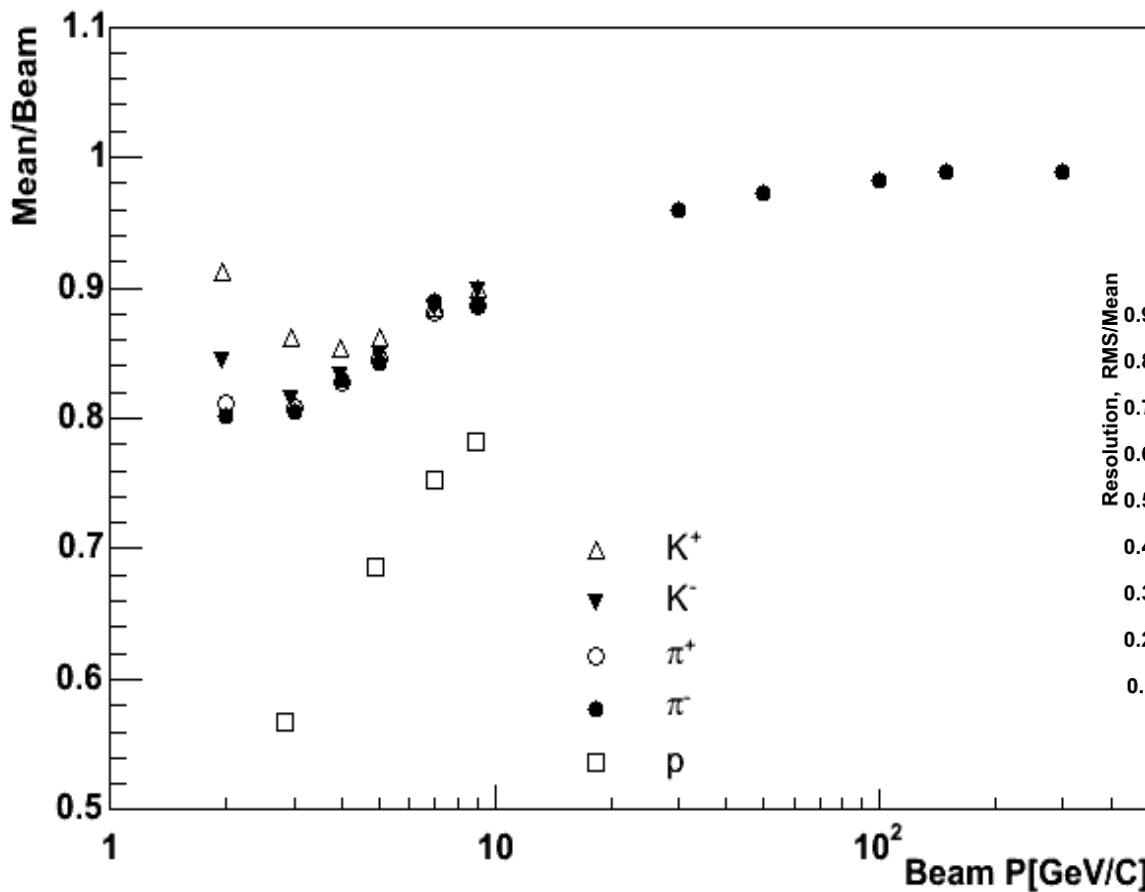
Two models in G4, QGSP and LHEP show different profile.



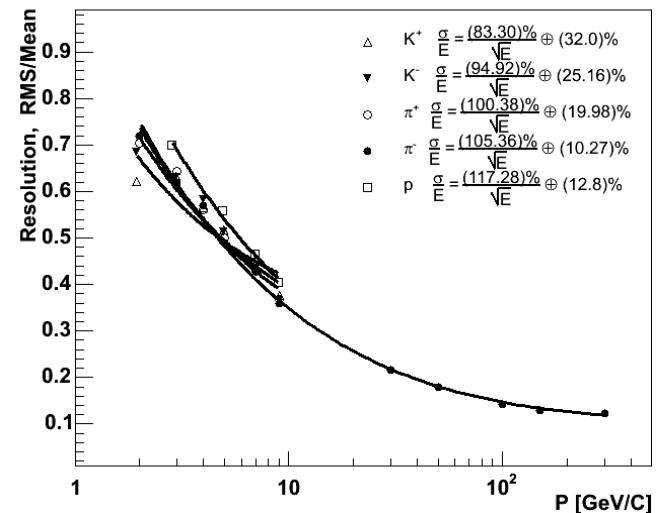


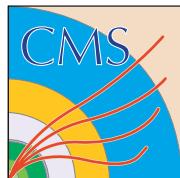
G4 Prediction

Linearity for ECAL+HCAL

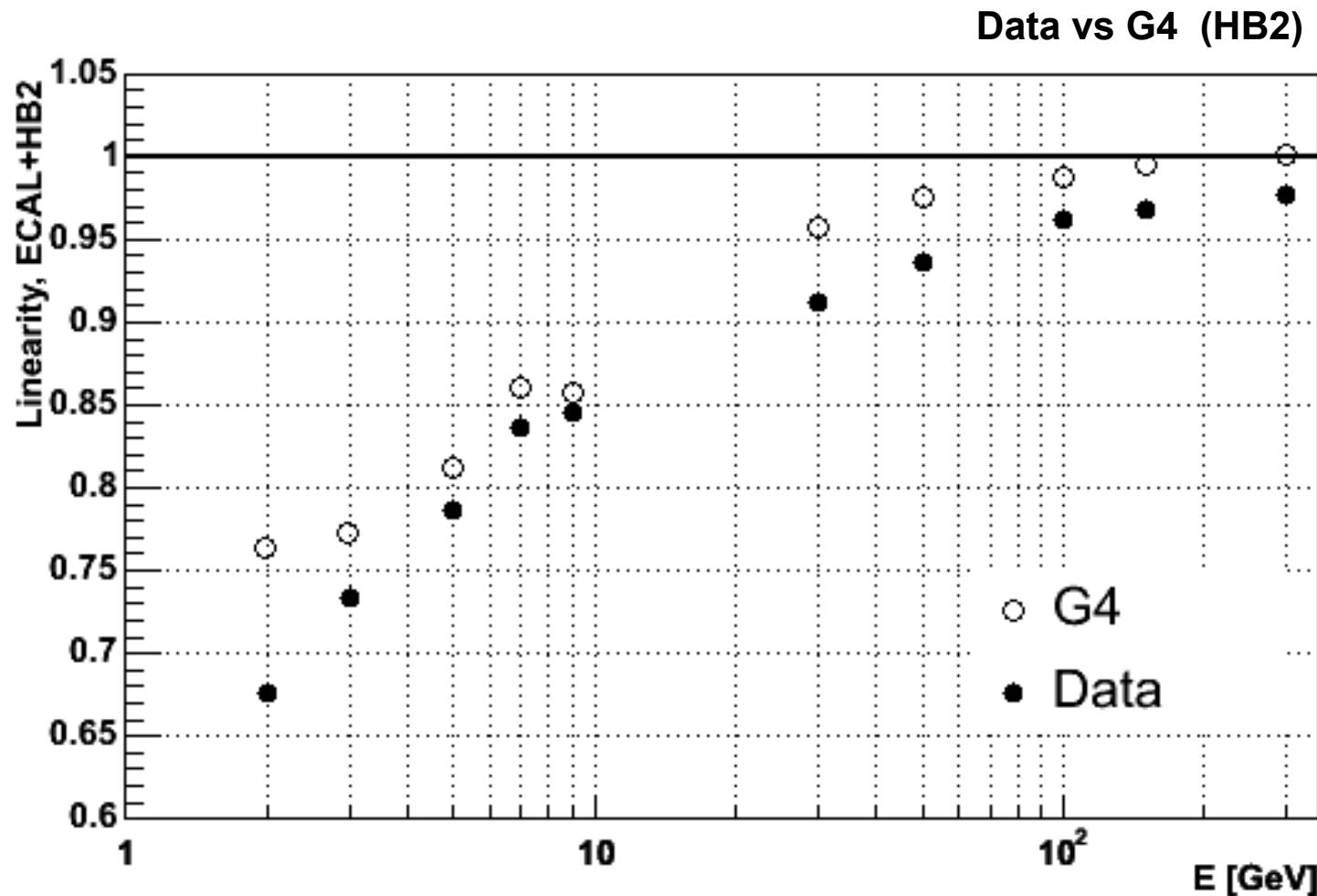


Resolution

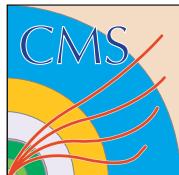




G4 vs Data: First attempt to overlay

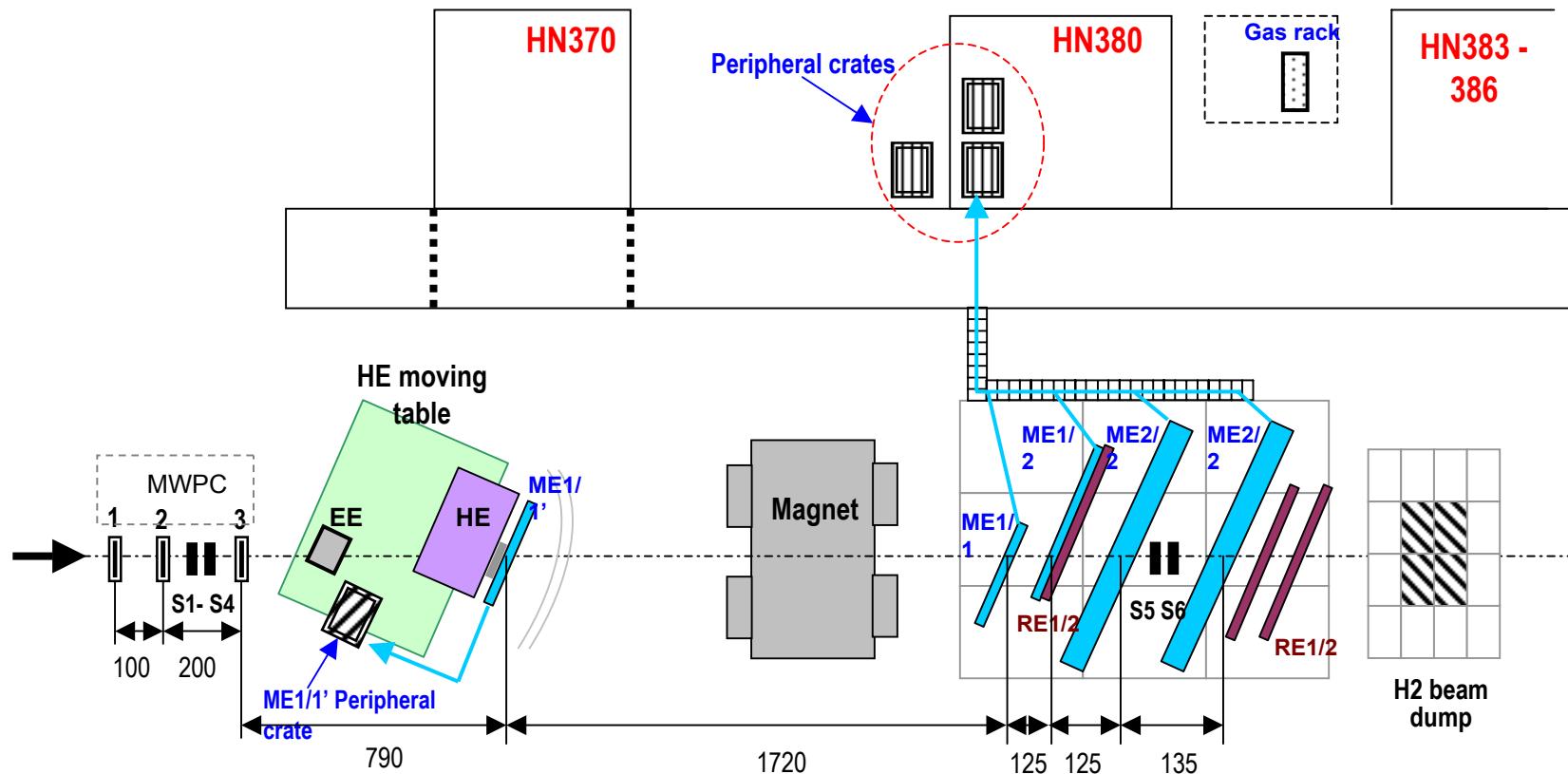


Need more clean-up!



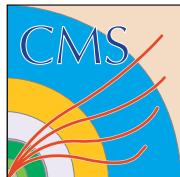
HE/ME Slice Test at H2

With 25ns beam in Oct.2004

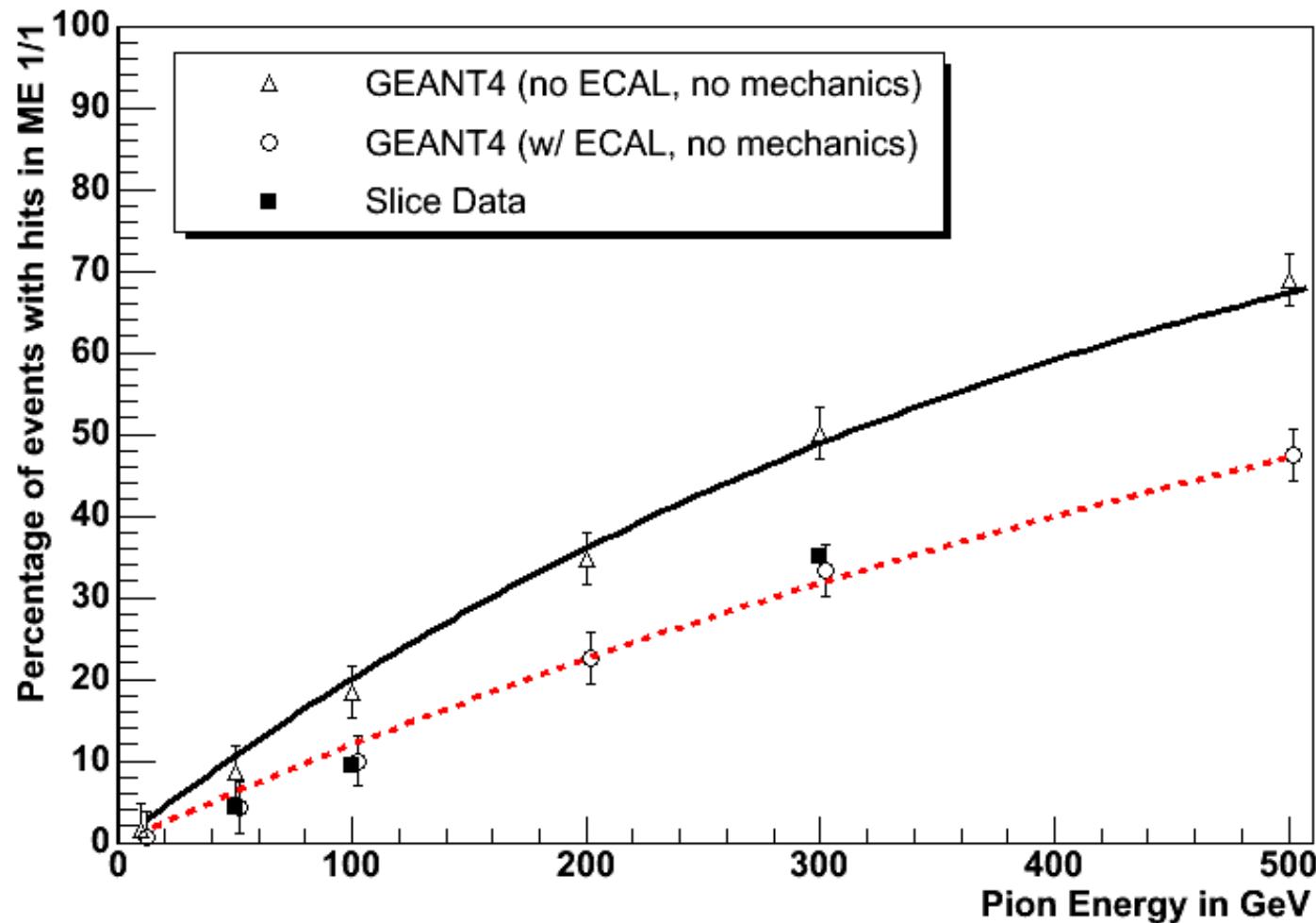


Length of optical links from peripheral crates – 50 m

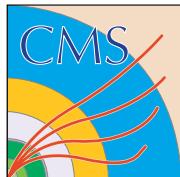
Counters: S1,S4 – 14 x 14 cm; S2 – 4 x 4 cm; S3 – 2 x 2 cm; S5 – 10 x 10 cm; S6 – 12 x 12 cm



Punchthrough: EE-HE-ME

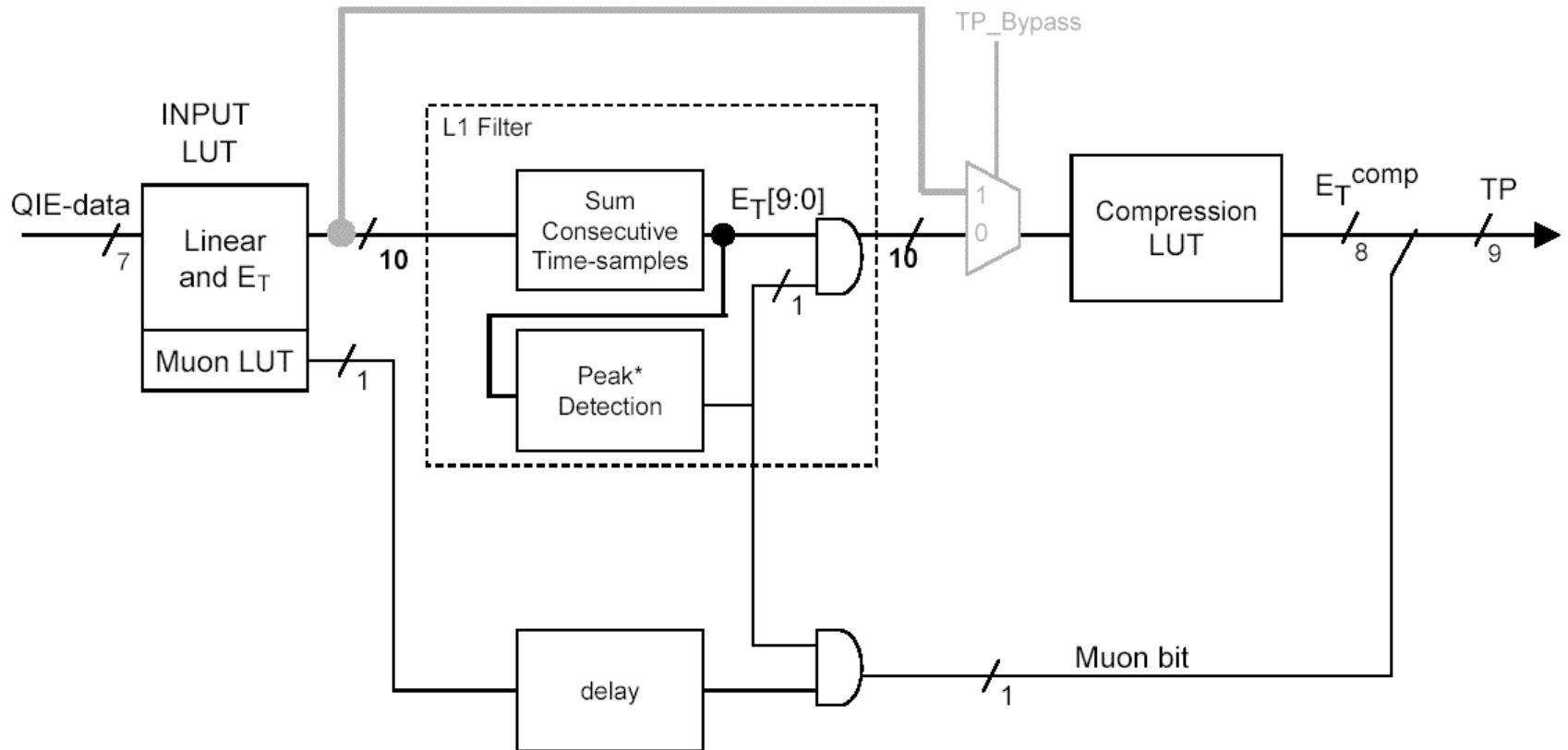


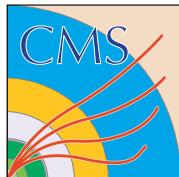
Readout from HE and EE were successfully synchronized!



Trigger Primitive Generation

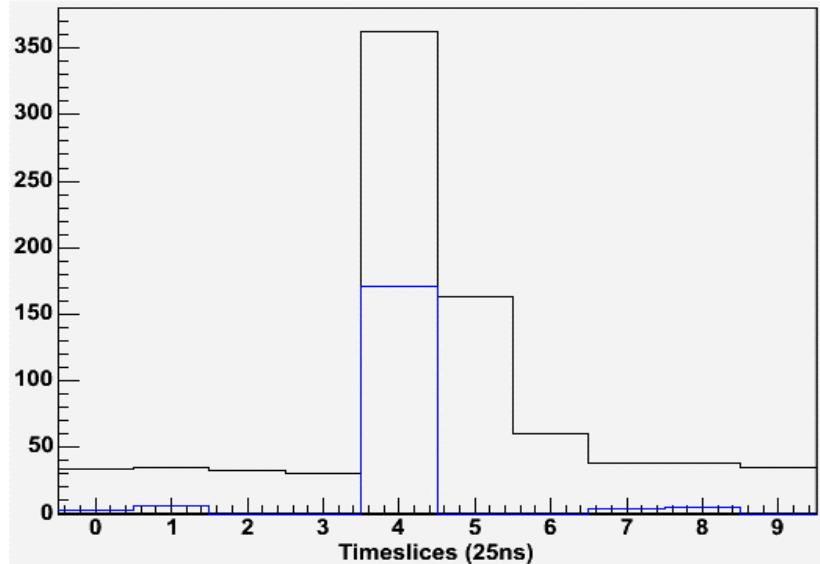
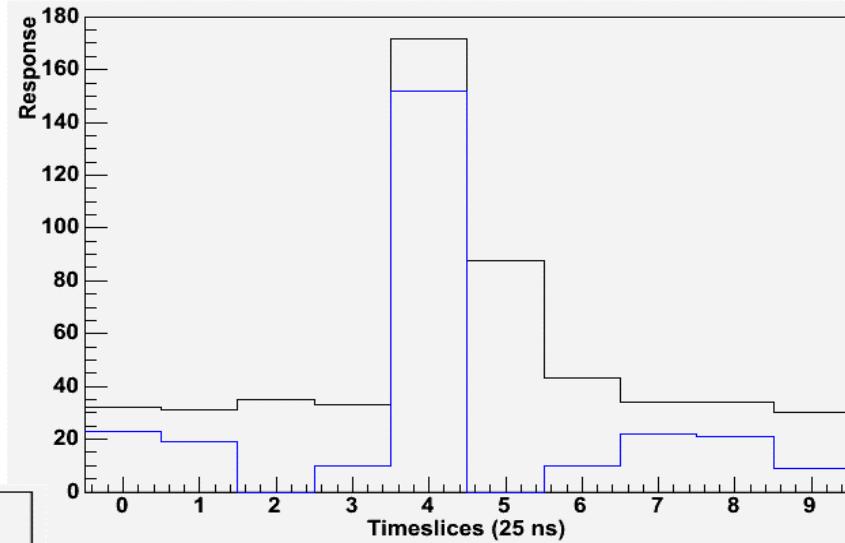
HTR: HCAL Trigger Readout



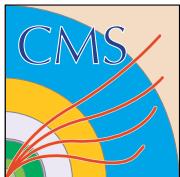


Example of Trigger Primitives

- 150 GeV pion event in HE with “identity matrix” LUTs
(Run #23905)

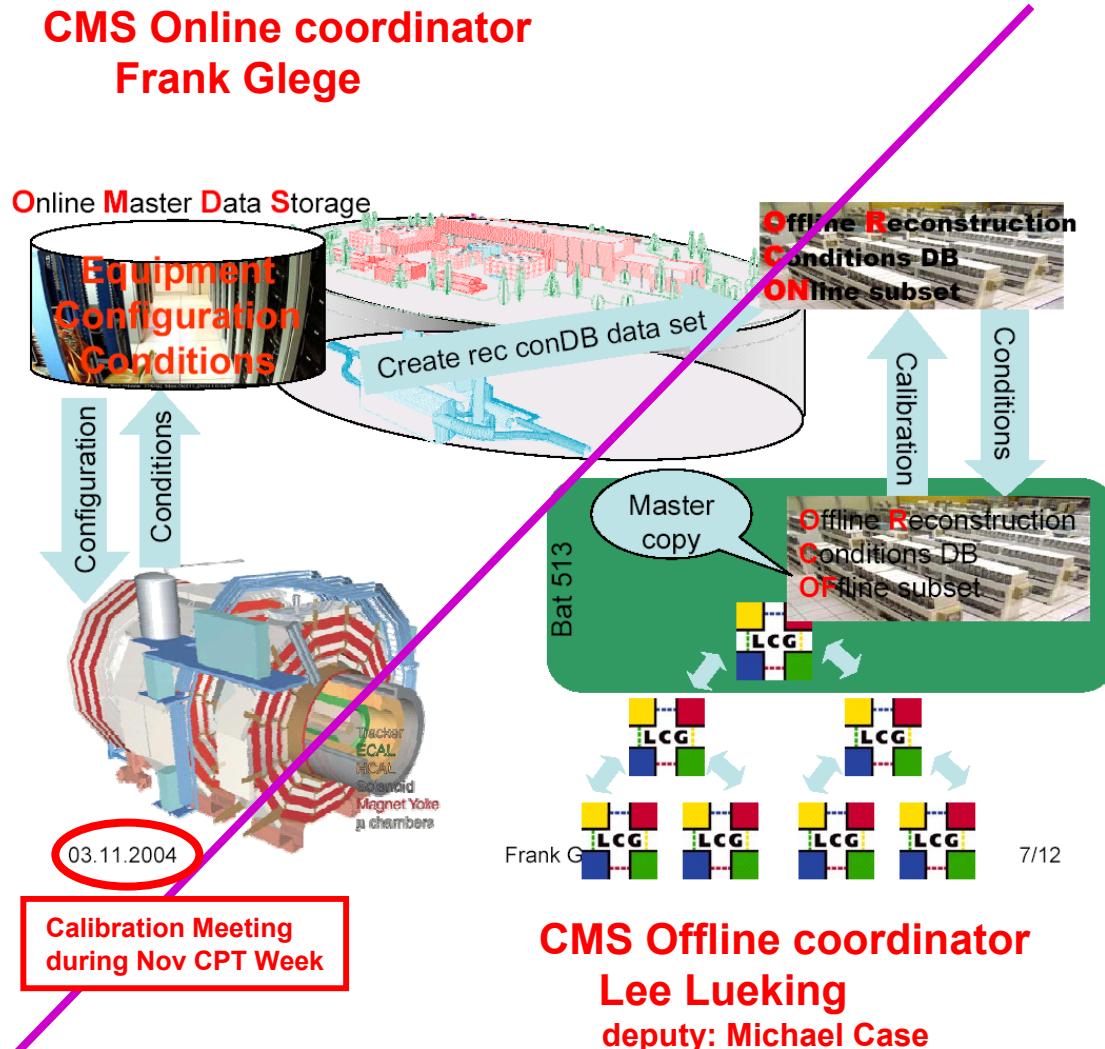


- 150 GeV pion event in HE with minimal $\cos(\theta)$ dependency in LUTs
(Run #23904)



Database

CMS Online coordinator Frank Glege



HCAL Prototype for TB2004

1 server at FNAL

1 server at H2

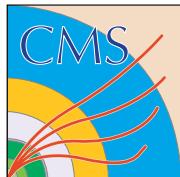
loaded-

gain, pedestal
HV monitoring

Magnet Test 2005

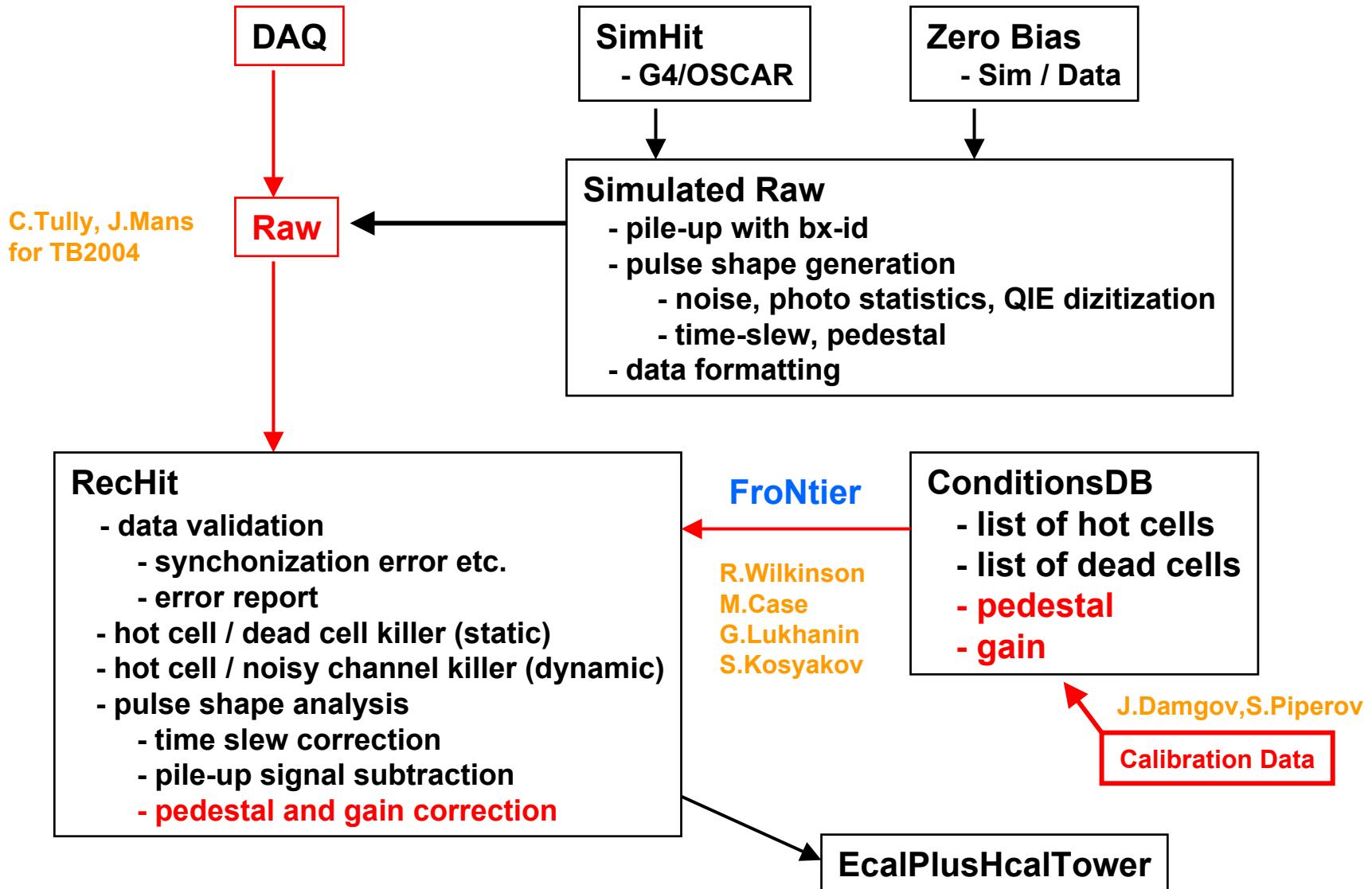
- Schema for all detectors.
- DBs filled with initial data.
- Complete data flow chain.
(All databases).
→ load initial constants for all HCAL channels.

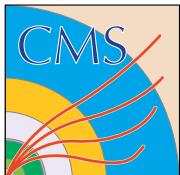
HCAL has built a DB team at FNAL and CERN with help from FNAL/CD. Working closely with PIXEL and EMU, and Dubna DB group.



ORCA: HCAL Data Flow

(R.Wilkinson/S.Abdullin)





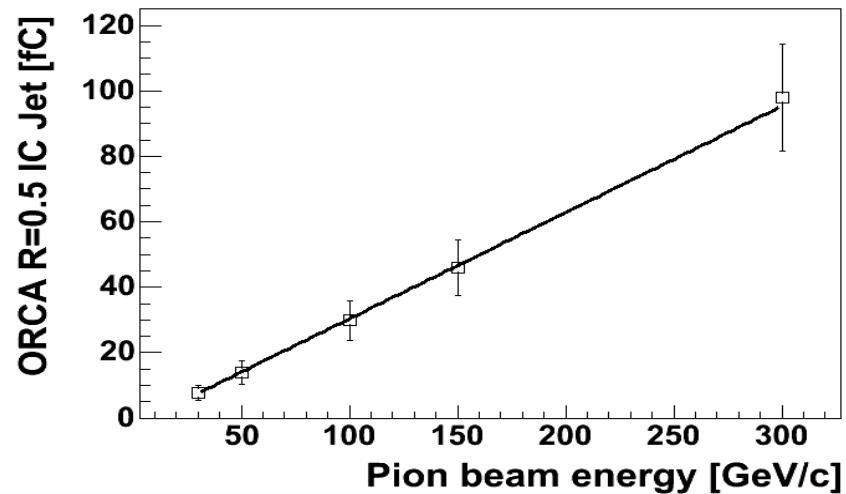
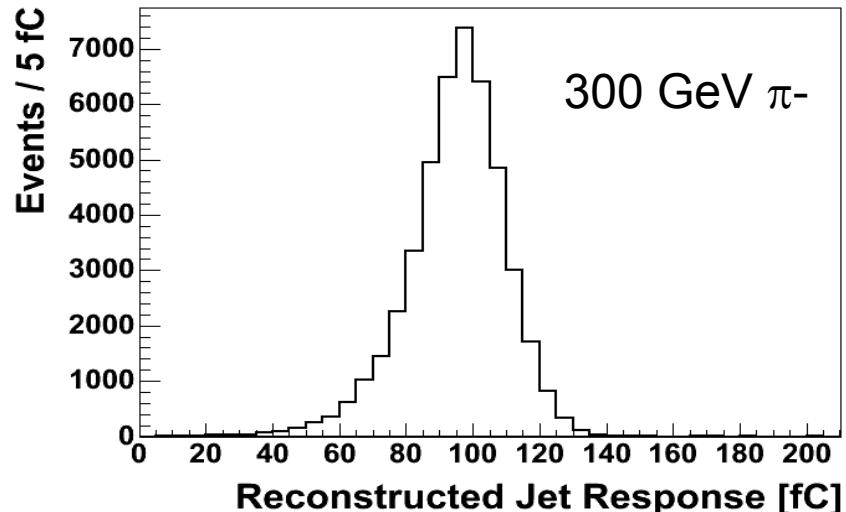
TB2004 data to ORCA

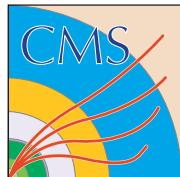
Example: reconstructing pion events on the bare HCAL as jets using the Iterative Cone algorithm ($R=0.5$)

- Full chain of creating dataframes, RecHits, and performing jet reconstruction has been demonstrated.
- No calibration/gain correction applied (results in fC)

Next:

Access to ConditionsDB through FroNtier





FroNtier

